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# SURGERY

## GYNECOLOGY AND OBSTETRICS

*An International Magazine, Published Monthly*

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NUMBER 1

### CANCER AND ITS RELATIONS TO PREGNANCY, TO DELIVERY, AND TO MARITAL AND SOCIAL STATUS

#### I Cancer of the Breast and Genital Organs

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USUALLY mice kept virgin or castrated have a much lower incidence of breast cancer than mated mice of the same strain (Lathrop and Loeb, and Lacassagne). In women the same relationship prevails only as far as cancer of the breast appears during the reproductive age. However, more than 80 per cent of breast cancers in women develop after the age of reproduction has passed. On an average the case histories in breast cancer show fewer pregnancies with about the same percentage of nulligravidae as in the corresponding social and age group of the general population (Weinberg and Gastpar, Lindstedt, Deelman, Peller). As to cancer of the genital organs, the situation varies even more, in the human, cancer of the genital organs is common, while in mice it is practically unknown.

At variance with the former generally accepted belief is the fact that the incidence of cervical cancer does not increase in direct relation to the number of pregnancies and deliveries (Peller, 1922). As to the frequency of cervical cancer, the first pregnancy and delivery are of much greater importance than are those which follow. As the incidence of cervi-

cal cancer due to pregnancies rises, there is more than a corresponding decrease in frequency of cancer of the body of the uterus, of the ovaries, and especially of the breast. Thus in women who have had 3 to 7 pregnancies, the total incidence of genito-breast cancer appears to be lower than in women who have had fewer or no pregnancies. On the whole, according to my clinical studies the effect of pregnancies and births upon the incidence of cancer in women is mainly (1) to transpose the primary tumors within the various parts of the body but to leave the total cancer incidence almost unchanged, and (2) to change the age at which the tumor appears.

For the first time some of these clinical findings can be tested on a nationwide statistical basis. The statistics regarding 94,400 cancer deaths occurring in England and Wales during 1930-1932 are now available for analysis and reveal marital and social status, age, organ affected, and the average number of births in 6 groups.

#### CANCER OF THE BREAST AND GENITAL ORGANS IN VARIOUS COUNTRIES

In most countries there are more victims of genital than of breast cancer. In England and Wales the difference has decreased more and

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TABLE I.—PERCENTAGE OF FATAL MALIGNANCIES IN WOMEN

	Breast	Other genital organs	Uterus
United States, census of 1926, n. f., 1925	30		
Canada, 1920 to 1925		?	
England and Wales, 1922		6	30
Rome, 1920 to 1922		7	24
Vienna, 1911 to 1925		8	
Berlin, 1921		?	
Prague, 1920 to 1925	20	?	10
Warsaw, 1920 to 1925			8
Madrid, 1911 to 1922	21	?	
Lisbon, 1922	22	?	
Budapest, 1909 to 1924	23	?	
Tokyo, 1904 to 1921	24		
Sydney, 1921 to 1924	26	?	10
New Zealand, 1924	2		17

more since 1930 more deaths have resulted from breast than from genital cancer. Neither the frequency of genital cancer or of breast cancer nor the proportion of each to the other has a fixed numerical relation to the birth rate (Table I).

England the United States of America, Australia, and New Zealand with their high percentage of Anglo-Saxons, have high ratios of breast cancer. This is also true in various countries in reference to Jewish women. German, Slavic, Magyar and Italian populations have lower ratios regardless as to whether the birth rate is high or low. As far as known Spain and Japan have the lowest ratio of breast cancer.

During recent decades a change is also noted in the numerical proportion of tumors of the ovaries to tumors of the uterus. The fact that more efficient registration is now maintained does not explain the increase in ratio of ovarian cancer in England and Wales from 12.2 per cent of all genital cancers in 1911 to 1920 to 24.9 per cent in 1931 to 1935. In Vienna, of 1685 genital cancers treated in the University Hospital during the period 1910 to 1919 only 11 per cent originated in the ovaries. In 1928 the ratio rose (according to the death certificate rates) to 23 per cent and in 1934 was as high as 30 per cent.

TABLE II.—ENGLAND AND WALES, STANDARDIZED CANCER MORTALITY PER 100,000 WOMEN

	Breast	Uterus and Ovary and Genitalia	Uterus	4 sites
1901 to 1920	27			24
1921 to 1925			2	24
1926 to 1929	26	2		27
1930	26	2		

From the English figures one learns that during recent decades the total mortality from cancer of the breast, plus uterus, plus ovaries, changed but little in spite of the fact that there is considerable change in the rates affecting each one of these three sites. The decline in birth rate was not followed by a decline in the mortality from cancer in these three sites taken together (Table II).

#### RELATION OF CANCER OF THE BREAST AND GENITAL ORGANS TO MARITAL STATUS

In spinsters over 54 years of age, the mortality from breast cancer is much higher than in married women who have about the same rates as widows. The greater mortality in spinsters cannot be explained by the small differences in the average age within each age group.

The period of physiological hormonal disturbances, the climacterium, is not especially marked. The steady increase in incidence due to increasing age is neither interrupted nor exceptionally hastened when compared with the previous or the following age decades. Single women of 45 to 54 years of age the rate rises more rapidly than in married women of the same age group (Table III).

As to cancer of the uterus, the mortality rate is higher in married women and widows than in spinsters. The difference is about twice as high in the childbearing age as in advanced age. The mortality rate in cancer of the uterus in widows over 44 years of age corresponds to that of married women or decennium older or single women about 15 to 20 years older. Thus widows of 45 to 54 years of age and married women of 55 to 64 years of age have about the same mortality rate in uterine cancer as do single women over 7 (Table IV).

TABLE III—ENGLAND AND WALES, 1930 TO 1932 BREAST CANCER ACCORDING TO MARITAL STATUS AND AGE

	25—	35—	45—	55—	65—	70—	75—	All over 25 years	
								Crude	Standard
1 Absolute number of deaths in 1930-1932*									
Spinsters	67	385	939	1 047	453	390	517	3 798	
Married†	200	1,315	3 001	3 019	967	577	418	9,497	
Widows and divorcees	3	109	524	1 096	834	894	2 060	5 520	
2 Number of women living 1931, in thousands									
Spinsters	1 105	573	431	306	109 7	77 3	73 9	2 676	
Married‡	2 203	2 222	1 897	1 213	319 1	168 9	88 2	8 111	
Widows and divorcees	41.4	159 1	305 2	440 2	263 9	247 8	341 3	1 798	
3 Average age of women at each age group, living 1931									
Spinsters	28 3	38 9	49 3	59 2	66 9	71 8	79 4	42 2	
Married	29 8	39 4	49 3	59 0	66 8	71 7	78 0	44 2	
Widows and divorcees	30 9	40 2	49 9	59 6	67 0	72 0	80 0	61 5	
4 Annual death rate per 100,000									
Spinsters	2 0	22 4	73	114	137	168	233	47 3	52 2±0 8
Married	3 0	19 7	53	83	101	114	158	39 1±0.4	
Widows and divorcees	2.4	22 9	57	83	105	121	201	102 2	41 7±0 9

\*There are some differences between the figures published in the 'Decennial Supplement Part IIa, Occupational Mortality' and those given in the 'Statistical Review Text'. Here as well as in the later tables figures for single and married women are taken from Table VIII of the 'Occupational Mortality'.

†Only one woman is below the age of 25.

‡Married of all 5 social classes and of the socially undetermined group.

In cancer development, the ovaries are involved much earlier than is any other of the genital organs or the breast. This may be considered a general rule throughout the world. As age advances the percentage of ovarian cancer decreases rapidly. In women less than 35 years of age the frequency of ovarian cancer does not depend upon the marital status. As single women advance in age, the incidence of ovarian cancer is greater than is that for married women or widows. Thus in single women of 45 to 54 years of age, the incidence of ovarian cancer is about the same as that for married or widowed women of 65 to 69 years of age.

When all genital cancers are considered together, it is found that widows over 45 years of age show the same mortality rates as single

women 10 years older and as married women a number of years older.

In all age groups spinsters have a higher incidence of breast than genital cancers, whereas married women, in England, have about the same incidence for both organs, and in widows cancer of the genital organs is more frequent.

When all genital and breast cancer deaths are considered together, the great differences enumerated disappear and what remains is partly the result of small deviations in the average age of the respective age group (Table III) and partly statistically insignificant or irrelevant.

Compared with those of married women, the fertility rates of single women are very low. In England, at the beginning of this century, 1000 married women between 15 and 45

TABLE IV.—ENGLAND AND WALES 1930 TO 1932. CANCER OF THE GENITAL ORGAN  
ACCORDING TO MARITAL STATUS AND AGE

	20	—	25—	25—	—	45—	75—		All over 25 years of age	
									Crude	Standard

## Absolute number of deaths from cancer of

## a. Uterus

Spinsters		41		266	277	146	21	1,111	294	
Married	6	57	381	1,134	1,412			1,40	7614	
Widows and divorcees		2	128	456	1,000	665		265	2620	

## b. Ovary

Spinsters			14	170	266	61	10		490	
Married		90	264	18	206	198	165		2029	
Widows and divorcees				30	12	16	292		350	

## c. Vagina andagina

Spinsters				10	20	23	24		791	
Married			20	20	161		16		294	
Widows and divorcees				26		17	210		290	

## Deaths per 100,000 from cancer of

## a. Uterus

Spinsters	62		8	25		30	27		16	2
Married			20	26.5		10		26	27	2.0
Widows and divorcees				62	75	24	65	24		62

## b. Ovary

Spinsters				20	20	27	24			2.4
Married	0.9	1.4	1.4		15	16.6			6	2
Widows and divorcees				14	10	20	16			2.4

## Vagina andagina

Spinsters	all					20	28			
Married						8	16		21	
Widows and divorcees							18			2

## d. All genital organs

Spinsters		8		22		27	124.8		10	2
Married				28		120				
Widows and divorcees			20	20.8	10	15	75		20	2

years of age gave birth to 235.5 children per year (1930 to 1932 the corresponding figure is 122.4) single women to only 8.5 children (1930 to 1932 to 5.8). At the beginning of the century in spinsters there is a high percent age of nulligravidae.

Thus one arrives at the following conclusions (1) the changes connected with and following pregnancy are not apt to increase the incidence of cancer in the total complex of genital organs and breast (2) An increase in births is followed by a transposition of the

TABLE V—ENGLAND AND WALES, 1930 TO 1932 MORTALITY FROM BREAST AND GENITAL CANCER PER 100,000 WOMEN BY MARITAL STATUS AND AGE

	25—	35—	45—	55—	65—	70—	All over 25 years	
							Crude	Standardized
Spinsters	47±0.6	38±1.5	117±3.0	189±4.5	225±8.3	304±8.2	77	85.6±1.0
Married	8.4±0.3	45±0.8	112±1.4	166±2.0	206±4.6	253±5.7	81.8±0.6	
Widows and divorcees	8.8±2.7	60±3.5	138±3.9	180±3.7	210±5.3	287±3.9	199	95.9±1.3

areas of cancer origin within the organs in question, and also by a slight decrease in total cancer rates (3) The decrease in total cancer also is partly counteracted by purely socio-economical and psychical events, such as the death of the husband

#### CANCER OF THE BREAST AND GENITAL ORGANS IN RELATION TO THE SOCIAL STATUS OF MARRIED WOMEN

The differences between single and married women heretofore discussed may have been affected partly by causes other than those connected with the parturient history. The excess of females over males makes it inevitable that some women remain unmarried. Selec-

tion of the mate is influenced by sociological as well as by bioconstitutional peculiarities and by pathological conditions. The more advanced the age, the more single women deviate as a whole from the average population, with a striking increase in death rate from nervous diseases, insanity, diabetes, suicide, and from accidents.

As far as fertility is concerned, married women of the highest social class—94 births per 1000 women between 15 and 44 years of age—are much closer to the married women of the four lower classes—90, 120, 133, and 152, per 1000—than to spinsters, who on the average have a fertility lower than 6. Applying the age specific fertility rates of all married women to each of the five social classes, the highest social class would have a fertility of about 107, the second class of 120, and the laboring classes of 125, 127, and 128 per 1000. Furthermore, taking the figures for 1930 to 1932 as constant, a married woman of the first class would give birth to 2.8 children on the average, of the second class to 2.7, of the third class—skilled workers—to 3.6, of the fourth to 4.0, and the wife of an unskilled worker—fifth class—to 4.5 children. These differences must

TABLE VI—ENGLAND AND WALES, 1930 TO 1932 AGE DISTRIBUTION OF MARRIED WOMEN AND BREAST CANCER RATES PER 100,000 BY AGE, MARITAL AND SOCIAL STATUS

Marital group	Social class	25—	35—	45—	55—	65—	70—
1 Number of married women in thousands							
Married	I	46.0	64.5	60.6	30.8	20.05	9.1
Married	II	267.6	373.2	370.1	240.6	63.2	51.0
Married	III	1137.7	1035.4	867.5	574.0	134.2	105.2
Married	IV	392.0	357.2	298.8	197.0	50.4	38.8
Married	V	354.0	332.6	284.2	188.3	46.2	31.4

2 Breast cancer per 100,000							
Spinsters	All	2.0	22	73	114	137	200
Married	I	(0.6)	27	71	116	160	140.5
Married	II	3.8	22	50	101	128	173
Married	III	3.0	20	55	84	103	135
Married	IV	2.4	17	45	68	87	1.4
Married	V	3.2	16	42	68.5	76	112
Widows and divorcees	All	2.4	23	57	83	106	167

TABLE VII—ENGLAND AND WALES, 1930 TO 1932 UTERUS CANCER RATES PER 100,000 BY AGE, MARITAL AND SOCIAL STATUS

Marital group	Social class	25—	35—	45—	55—	65—	70—
Spinsters	All	1.3	8	22	41	50	61
Married	I		12	26	47	67	55
Married	II	3.1	14	35	51.5	76	94
Married	III	3.4	20	44	63.5	75	94
Married	IV	3.9	24	47	63	89	89
Married	V	6.5	20	50	75	78	99
Widows and divorcees	All	4.0	31	64	76.5	84	85

TABLE VIII — ENGLAND AND WALES, 1930 TO 1932 CANCER OF GENITAL ORGANS PER 100,000 BY AGE, MARITAL AND SOCIAL STATUS

Marital group	Social class	—	—	5—	6	70—
Spinsters	A5		44		52	102
Married	I	7	26	73	51	60
Married	II		30	73	16	41
Married	III	8	34	84	126	34
Married	IV	2	27	37	76	30
Married	V	6	34	71	94	100
Widows and divorcees	A3	4	26	2	97	14

be taken into consideration when an analysis of cancer based on the social status is made.

The death rates for cancer of the breast diminish from the first to the fifth social class (Table VI).

If only the number of pregnancies were a factor in determining breast cancer rates, then women of the professional class—class I—would have much lower rates, and spinsters—of all classes combined—would have higher rates than they actually do. Taking into consideration the small difference in the breast cancer rates between these two groups of women one would have expected many more women of the three laboring classes to have breast cancer than they do. Therefore factors other than fertility must be regarded as acting directly upon breast cancer incidence, or these factors as well as pregnancy may be acting upon other organs and thus indirectly influence breast cancer rates.

Whatever factors influence breast cancer also have a similar bearing upon ovarian cancer. For cancer of both the breast and ovaries the following standard rates per 100,000 are given for all ages above 20 years: single women 62; married women of the first class, 61; married of the third class 46; and of the fifth class, 37. Four-fifths of the differences in rates of breast and ovarian cancer between married women of the five social classes are counterbalanced by opposite changes in the mortality rates from uterine cancer. The figures for uterine cancer in married women rise inversely with social status and run parallel with fertility rates. The differences are considerable (Table VII).

It may be stressed again that the rates of incidence for married women of the highest social class are much closer to that of single women than to any other class of married women, the standard figures for cancer of the uterus being for spinsters over 20 years of age 17 and for married women of the first, third and fifth class, 20, 30 and 39 per 100,000, respectively. The last figure is identical with that for widows.

Summarizing the figures for all genital cancers, the standard rates for all ages above 20, rise more slowly for spinsters,  $31.6 \pm 0.9$  for married women of the highest social class,  $33.5 \pm 3.7$  for women of the third social class—skilled workers,  $40.4 \pm 1.0$  and for the wives of the unskilled workers,  $47.9 \pm 1.9$  whereas widows, of all classes together had a standard rate of  $50.8 \pm 0.9$  per 100,000. The difference between the first and fifth class is  $14.4 \pm 4.1$  genital cancer deaths per 100,000 married women between the first and third class,  $6.9 \pm 3.8$  between the third and fifth class,  $7.5 \pm 2.1$  between the single women and those married to skilled workers,  $8.8 \pm 1.3$  between single women and wives of unskilled workers,  $16.3 \pm 2.1$  between single women and widows,  $19.3 \pm 1.3$  per 100,000.

The age specific death rates for all cancer of the genital organs per 100,000 patients are given in Table VIII.

On an average the social and economic status of single women is below that of married women of the first social class. If only the social factor were operative, spinsters should have a much lower rate of ovarian (and breast) cancer and a higher rate of uterine cancer than married women of the first class. This, however, does not conform with facts. From the point of view of fertility spinsters should have higher ovarian (and breast) cancer incidence but lower uterine cancer incidence than they actually have. Again there is a discrepancy between expectation and facts. Apparently both the biological and the social factors interfere with one another thus levelling out the divergent tendencies. Therefore the standardized total mortality from genital plus breast cancer for single women is very close to that of married women of the highest class. The influence of both the biophysiological and the

TABLE IX—ENGLAND AND WALES, 1930 TO 1932 MORTALITY FROM CANCER OF BREAST AND GENITAL ORGANS

Marital status	Social class	20—	5—	35—	45—	55—	65—	70—	Standard mortality for all over	
									20	25
									years of age	
Spinsters	All	0.9	4.7	38	117	180	225	304	81	86
Married	I		1.4	44	119	100	253	281	83	87.6
Married	III	1.4	8.1	44	114	168	208	260	79	82.8
Married	V	1.5	11.7	51	113	162	176	236	78	82.1
Widows and divorcees	All		0.0	60	138	180	220	287	90	96

sociological factors has to be considered also in comparing married women and widows. The latter have much higher death rates than the average married women, this is especially true in the age groups 35 to 44 and 45 to 54 (Table IX).

In the ages above 45 the combination of a higher birth rate with a lower social status does not raise the mortality of the total of breast and genital organs but rather lowers it. Decline in birth rates does not diminish but rather increases the incidence of genito-breast cancer, regardless as to whether the decline is associated with a higher or a lower standard of life. The effect of both, biological factors—pregnancies—and social status, upon the total mortality from breast and genital cancer combined is clearly evident in the age specific death rates, the effect is, however, much less evident if standardized rates are used.

#### ANALYSIS OF STUDY

It has been shown that all three conditions, namely, the lowering of the social and economic status, the increase in birth rate, and the condition following the death of the husband, tend to increase mortality from cancer of the uterus, whereas the percentage of breast cancers is increased by the third, and lowered by the first two conditions. The compensatory relations between the two—the genital and breast cancer—are obvious by comparing statistics for nulligravidae with those for gravidae, or of oligoparae with those of multiparae, or of those for spinsters with those of married women, this relation is lacking, however, if statistics for married women are compared with those for widows. Widows have higher

breast cancer rates in spite of the fact that they have higher rates of genital cancer. The fact has been established that changes in social standards, either improvement or deterioration, and tragic family events primarily influence the age at which the cancer manifests itself. Differences of 10, 20, or even more years due to marital status have been shown here. That is of importance in itself and to the question as well, as to whether the cancer campaign could use the principle of prolonging the average life without changing the total number of cancer victims.

#### SUMMARY AND CONCLUSIONS

1 The distribution of primary neoplasms within the breast and genital organs, and the age specific death rates from cancer of each part are widely influenced by *birth rates*, the total mortality from cancer of the breast and genital organs, however, varies only to a small degree, as an increase in incidence in one organ is compensated for by a decrease in incidence in other organs, and vice versa. The compensation is not an exact one, for populations with higher birth rates have a rather diminished mortality. These findings are corroborated by my clinical studies (1922 to 1923).

2 From the standpoint of *social status* the changes in the incidence of uterine cancer and breast cancer become apparent. These changes are independent of those due to purely biological relations, that is fertility and cancer rate.

3 In contradistinction to the factors considered under (1) and (2), circumstances attendant upon the *husband's death* are apt to increase the mortality from both uterine and



breast cancer and so to change the age specific frequency of cancer affecting both organs.

4 The lower the social level and the less satisfactory the *marital status* the earlier the patient manifests cancer or dies from it

5 The correlation between cancer and pregnancies in *women* is entirely different from that in *men*

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# NUPERCAINE ANESTHESIA

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IN the literature there is a broad and comprehensive discussion of anesthetic agents and indications for each. Among the more recent publications Sise (10) presents a summary of the agents and methods. It is our purpose, first, to discuss a limited phase of anesthesia, subarachnoid block or spinal anesthesia, and one particular agent, namely, nupercaine<sup>1</sup>, also known as percaine, and second, to present a report of our series of cases in which the Lahey clinic technique, adapted by Woodbridge from Jones and Hewer, was employed.

Rapid strides have been made in spinal anesthesia from the original studies with cocaine. From cocaine, allied substances have been evolved, namely, procaine, metycaine, and the more recent agent, pontocaine. The goal of investigators, pharmacologists, and clinicians has been an agent that would combine the important factor of lessened toxicity with increased duration of anesthesia. Of this group, pontocaine approaches most closely the ideal agent for spinal anesthesia. However, it has two important limitations: first, the relation of the specific gravity of the present 1 per cent solution to the varying specific gravities of the different spinal fluids, and second, the duration of anesthesia to be anticipated. We believe the first limitation is remedied by insuring a hyperbaric solution with the addition of 10 per cent glucose solution and depending on gravitational methods for anesthetic levels, as reported by Sise (11). The usual duration of anesthesia with pontocaine varies from 1½ to 2½ hours, depending on the dosage and site of operation. For the majority of operative procedures, therefore, pontocaine glucose mixture is, at the Lahey clinic, the anesthetic agent of choice. With this technique the height of anesthesia is accurately controlled and the onset is rapid.

With certain operations it is desirable to have anesthesia of longer duration than that

produced by pontocaine, but without any increase in depressive effects, in others a hypobaric solution is preferable because of the position of the patient during operation. In these cases we have selected nupercaine, 1:1500 dilution. Therefore, the use of this drug is limited to two general types of operation: first, long upper abdominal operations, chiefly gastric resection, and second, operations of positional importance in which a hypobaric solution is indicated. Due to the limitations noted the number of these cases is necessarily small.

## CHEMISTRY

Nupercaine synthesized by Miescher is alpha-butyloxycinchonic acid di-ethyl-ethylene-diamide hydrochloride. It is a colorless, odorless, tasteless, crystalline substance with a neutral reaction, readily soluble in water and alcohol, and may be boiled repeatedly without decomposition. In a solution even slightly alkaline the drug precipitates as a free base. The solution now used at the Lahey clinic is that supplied by the manufacturers in 20 cubic centimeter sterile ampuls of 1:1500 dilution in 0.5 per cent sodium chloride. The specific gravity of this solution Jones reports as 1.00345 at 35.5 degrees Centigrade. Levinson presents a table of specific gravity readings of spinal fluid varying from 1.001 to 1.010<sup>2</sup>. Therefore this solution, with very few exceptions, is hypobaric or lighter than spinal fluid.

## PHARMACOLOGY

Accurate pharmacologic investigation by Lipschitz and Laubender has shown nupercaine, by intravenous injection, to be twice the toxicity of cocaine when injected into rabbits.

Saklad, reviewing the work of Nowak and of Wiedhopf, presents an excellent compara-

<sup>2</sup>The specific gravity readings of spinal fluids as compiled by Levinson: Hoppe 1.001 to 1.005; Halliburton 1.007 to 1.008; Kazka 1.002 to 1.008; Zdarek, 1.007; Polanyi 1.005 to 1.007; Mestrezat, 1.007; Nawratzka 1.008; Penda 1.007 to 1.010; Borelli and Data, 1.007 to 1.009; Williamson 1.005 to 1.009; Hammerstein 1.007 to 1.008; Eskuchen 1.006 to 1.007; Levinson 1.003 to 1.007.

From the Department of Anesthesia, the Lahey Clinic.

<sup>1</sup>Ciba for spinal anesthesia.

tive summary of the fatal intravenous doses of the various agents. Nowak found that in cats the average fatal dose of procaine was 49.6 milligrams per kilogram for metycaine the average fatal dose was 28.8 milligrams per kilogram the ratio compared to procaine 1.7 the dose ratio 0.8 the corrected toxicity ratio compared to procaine 1.36 for pantocain the average fatal dose was 8.6 milligrams per kilogram, the ratio compared to procaine 5.8 the dose ratio 0.1 the corrected toxicity ratio compared to procaine 0.58 for nupercaine the average fatal dose was 3.5 milligrams per kilogram, the ratio compared to procaine 14.2 the dose ratio 0.05 the corrected toxicity ratio compared to procaine 0.71. Wiedhopf found that in rabbits the average fatal dose of procaine was 57.5 milligrams per kilogram for pantocain the average fatal dose was 8 milligrams per kilogram, the ratio compared to procaine 7.18 the dose ratio 0.1 the corrected toxicity ratio compared to procaine 0.71 for nupercaine the average fatal dose was 3 milligrams per kilogram, the ratio compared to procaine 19.16 the dose ratio 0.05 the corrected toxicity ratio compared to procaine 0.958.

Gemner and Nauheimer report nupercaine to be 7 to 50 times more effective than novocain, and in dilute solutions to have very little effect or a slight dilating action on the vascular channels of warm blooded animals.

W. H. Jones states "By laboratory test percaine is proved to be ten times stronger than cocaine and twenty times stronger than novocain, and therefore far more toxic than either but as toxicity is in a great measure dependent on concentration and percaine is effective in extreme dilution toxicity in practical use, is reduced to such a level that symptoms are not produced

#### TECHNIQUE, PRECAUTIONS, AND SUPPLEMENTARY ANESTHESIA

The members of the department of anesthesia at the Labey clinic are firm advocates of adequate pre-operative medication. For good risk patients our average pre-operative medication consists of  $\frac{1}{32}$  grain pantopon,  $\frac{1}{150}$  grain scopolamine subcutaneously 2 hours before the scheduled time for operation

and 3 grains nembutal by mouth, 1 hour before operation. In cases of vomiting, obstruction, or when for any reason oral medication is contra indicated, the nembutal is given by rectum. We prefer pantopon to morphia, as our clinical impressions suggest less incidence of nausea and vomiting during the operative procedure. This observation is being statistically reviewed at the present time by members of our department. The doses of pre-operative medication are elastic, and depend on the opinion of the anesthetic risk formed when the anesthetist interviews the patient the day before operation.

When patients arrive in the operating suite they are usually in a drowsy or euphoric state of mind ideal for surgery on conscious patients. Occasionally there is little or no effect from their pre-operative medication. With these cases previous medication is reinforced with varied doses of morphia and scopolamine intravenously usually  $\frac{1}{6}$  to  $\frac{1}{12}$  grain morphia,  $\frac{1}{300}$  or  $\frac{1}{300}$  grain scopolamine either just prior to spinal puncture or preferably after the desired anesthetic level has been obtained so as to insure the optimal co-operation of the patient.

All patients for spinal anesthesia are given 50 milligrams of ephedrine sulphate intramuscularly as the first step. We feel that, within reason the greater the time interval between the ephedrine and the anesthetic solution injection, the better the inhibiting response on blood pressure fall that may occur following injection of the anesthetic solution.

For operations in the upper part of the abdomen the dose of nupercaine solution varies from 16 to 20 cubic centimeters. The height and sex of the patient determine the proper dose 16 cubic centimeters for a 5 foot woman and 20 cubic centimeters for a 5 foot man for every 3 inches over 5 feet, 1 cubic centimeter of nupercaine solution is added 20 cubic centimeters is the maximal dose. For anesthesia lower than the area mentioned divide 100 by the number of the uppermost thoracic nerve segment which is to be anesthetized. The result is the quantity in cubic centimeters, of nupercaine solution to be used. For example anesthesia desired to the umbilicus, innervated by the ninth thoracic nerve 100

divided by 9 equals 11, thus the estimated dose will be 11 cubic centimeters of nupercaine solution

While we do not advocate rigid doses for any drug but feel rather that the dose depends on a number of factors, all of which should be considered in estimating its size, the authors believe that with nupercaine, 1:1500 dilution, it is the volume of the solution that is the important factor in obtaining the optimum anesthesia, both in desired level and in duration of anesthesia. Occasionally the risk of the patient influences the dosage, by not more than 1 or 2 cubic centimeters of solution.

Before proceeding with the discussion of the technique proper, we wish to mention two important preliminary steps in anesthesia with nupercaine. First, we recommend that both the ampul of nupercaine solution and the 20 cubic centimeter syringe be warmed to at least body temperature and preferably slightly above. We believe this procedure is an aid in obtaining a satisfactory and evenly distributed anesthesia. Second, as nupercaine is precipitated in the presence of an alkaline medium it is important to insure a slightly acid reaction in the spinal needle and 20 cubic centimeter syringe. Since the nupercaine solution as prepared by the manufacturer has a slightly acid reaction 1 cubic centimeter is effective as a rinsing solution for syringe and needle to assure that they contain no trace of alkalinity. The 1 cubic centimeter of solution which has been used for rinsing may now be transferred to a 2 cubic centimeter syringe with the addition of a small quantity of normal saline solution to increase the bulk, and be used as the anesthetic agent for local infiltration at the site selected for lumbar puncture.

For all spinal punctures we use the combination of the Lahey clinic introducer and gold needle. This needle is of a No. 21 gauge with stylet. The use of the introducer is almost a necessity in piercing the highly resistant interspinous ligament with such a limber needle (Fig. 1).

The most satisfactory site for spinal puncture in upper abdominal cases with nupercaine anesthesia is the second lumbar interspace. Our clinical experience has shown greater consistency in obtaining the desired anesthetic

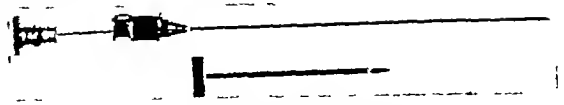


Fig. 1 Lahey clinic gold needle and introducer

levels in upper abdominal operations when this interspace is used rather than the lower lumbar interspaces. After local infiltration with the solution mentioned, puncture is made with the patient lying on his left side in the level position. We prefer to withdraw and discard approximately 5 cubic centimeters of spinal fluid for two reasons: (1) to lessen any tendency to sudden severe headache that might occur during the injection of this volume of solution, and (2) to insure a more consistent anesthesia. Next, the previously estimated and prepared warm anesthetic solution is injected at the rate of 0.5 cubic centimeter per second. Immediately following this injection, the patient is turned to a prone position, without pillows under the head.

In pelvic or lower abdominal surgery a level or a slight Trendelenburg prone position is sufficient for anesthesia, and the patient is returned to supine position and may be placed immediately in steeper Trendelenburg position. In upper abdominal operations we wish the height of anesthesia to reach approximately to a level between the second and fourth thoracic nerve segments. In order to make the light nupercaine solution run to the desired position in the spinal column, by means of a thyroid bar under the upper portion of the patient's sternum (Fig. 2, a), we raise these areas to approximately a 15 degree angle to a horizontal plane, with special care that the head of the patient is lower than the uppermost thoracic area. This procedure causes the solution to flow to and settle in the highest region of the spinal canal, which in this position is approximately between the second and fourth thoracic segments, and prevents the solution from running high enough to involve the important cervical roots from which the phrenic nerves arise. When a thyroid bar is not available the patient may be placed prone with his head and arms over the end of the operating table and the table may then be tilted to 10 or 15 degrees—Fowler position—(Fig. 3) special care being taken that

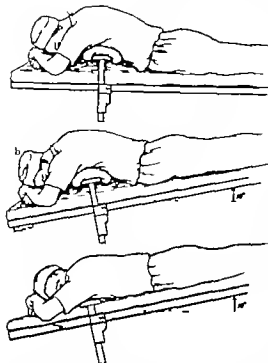


Fig. 1. a. Recommended position of patient for obtaining desired height of anesthesia. b. Position after obtaining height before thyroid bar is lowered. c. Position after lowering thyroid bar prior to turning patient supine.

the patient's head and neck are always lower than the upper thoracic level.

By means of a pinching clamp to elicit definite response to pain stimulus we test for the height of anesthesia within 2 minutes after injection. This is usually done along the right axillary line though it must be borne in mind that in a few instances anesthesia will be found at a higher level on the left. The usual lapse of time to obtain the desired level of anesthesia ranges from 4 to 5 minutes.

When anesthesia has reached the desired level first the table is placed at a 5 to 10 degree Trendelenburg position (Fig. 2 b) and second the thyroid bar is completely lowered under the patient's sternum (Fig. 2 c). Only after Trendelenburg position has been assured to prevent further cephalad rise of anesthesia, should the patient be turned supine. Here again, as always with this technique care should be taken to have the head of the patient in the most dependent position. By

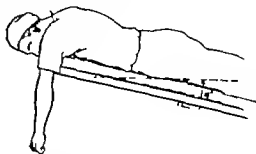


Fig. 2. Optional position for obtaining desired height of anesthesia.

the time the anesthetist has completed his preparations and the patient is ready for operation, anesthesia will usually be found to be one to two segments cephalad to the segment tested in the prone position.

Rarely we find that a level of anesthesia is obtained more rapidly and possibly higher 2 to 4 minutes after injection and that it has extended higher than desired. It is for these cases one must be on the alert by early and frequent testing. When one encounters such cases the patient should immediately be placed in 10 degree Trendelenburg position and the lift bar completely lowered leaving the patient in the same prone position for approximately 7 to 8 minutes, if his condition permits. This insures a complete bathing of the sensory or posterior nerve roots by the hypobaric anesthetic solution and also causes this solution to retreat somewhat from its extended position so that when the patient is turned supine the anterior or motor roots will not be affected as far cephalad. These patients occasionally have upper intercostal paralysis for a brief period. The mental state of the patient and the objective degree of paralysis will then influence further procedure. Usually light supplementary anesthesia will suffice to alleviate the disturbed mental state of the patient. If the patient is kept abundantly supplied with oxygen it is remarkable how little disturbance is caused him even by considerable respiratory paralysis.

A peculiar type of reaction occasionally occurs with this method of anesthesia. One to 2 minutes after the patient is placed in the prone position shoulders elevated head lowered from the highest point of elevation there

occurs a severe fall in the patient's blood pressure, almost to a pulseless state, with an associated state of unconsciousness. Early frequent questioning by the anesthetist soon elicits the change in the patient's response, from the halting, slurring speech to a state of unconsciousness with no other premonitory symptoms such as retching or nausea. This reaction is probably due to cerebral anemia from a number of factors, the prone position with elevation of the shoulders probably being the chief contributing factor.

The original method of treatment was Trendelenburg position, lowering the shoulders and then turning the patient to a supine position. The response was almost immediate, with return of consciousness and improvement of blood pressure to approximately the former normal level. This change in position, however, usually interfered with the induction of anesthesia. The prone technique was therefore re-employed in an attempt to obtain the desired height of anesthesia.

In a few of our recent cases the new cardiovascular stimulant reported by Melville, Raginsky (7), and Bourne (8), has been used intravenously with as satisfactory a response as obtained by a change in position. The method employed is an intravenous injection of approximately 2 to 3 minims of a previously prepared mixture of posterior pressor principle of the pituitary gland and ephedrine into the tubing of the already functioning constant infusion apparatus. This procedure permits the patient to remain in the original prone position, thus assuring the desired height of anesthesia with no apparent untoward effects on the patient.

The recommended solution is a balanced mixture of 5 units of posterior pressor principle, the trade name of which is "pitressin," and  $\frac{3}{8}$  grain or 25 milligrams of ephedrine. This combination is an excellent cardiovascular stimulant, for two reasons: first, small doses can safely be given intravenously and give immediate pressor response; second, if the total dose is also given subcutaneously it not only improves the vascular tone but retains it at the improved levels for an appreciable period of time. Repeated doses can be given subcutaneously or intravenously.

Failures with this technique of anesthesia have been few. In cases in which sensory effect has been insufficient, motor relaxation has been excellent and usually of from 3 to  $3\frac{1}{2}$  hours' duration. In these cases sensation has been satisfactorily obliterated by a light supplementary anesthesia. This supplement can be either by inhalation or by intravenous administration.

#### REPORT OF CASES

The total number of cases in which nupercaine anesthesia was employed up to September, 1938, is 251. In the majority, numbering 180 cases, the 1:1500 solution and the technique described were used to obtain the desired anesthesia. During the period of investigation, (a) 38 patients were anesthetized with this technique but 1:1000 solution was used, and (b) 33 patients were anesthetized with the 1:1500 solution but varying sites of injection and position were used. A detailed case report will be made concerning the 180 cases. The remaining series of 38 and 33 cases, respectively, will be grouped together, numbering 71 cases, and will be presented by tables under the consideration of complications.

We present our small series of cases numbering 180, keeping in mind the limitation in the use of nupercaine to two general types of operation: first, operations that we suspect will continue beyond the usual duration of anesthesia safely obtainable with the other agents commonly employed; second, operations of positional importance in which the hypobaric solutions and methods are indicated rather than the hyperbaric solutions. The first type for future reference will be classified as the group of necessity or Group A. The second type for future reference will be classified as the group of election or Group B.

*Operation.* The vast majority of operations under nupercaine anesthesia were major surgical procedures on serious risk patients. Table I lists the type, number, and percentage of total cases, divided into Groups A and B.

In Group A under gastric surgery are included gastric resection, total and subtotal, lysis of malfunctioning gastro-enterostomy, gastrostomy and gastro-enterostomy, resection for gastrojejunocolic fistula involving re-

TABLE I.—NUMBER AND TYPE OF CASES

Type of cases	Number	Per cent of total
Group A		
Gastric surgery		6.7
Biliary tract surgery		5.5
Large bowel surgery*	3	7
Small bowel surgery	4	
Total	13	76.6
Group B		
Pelvic organ surgery		22.7
Kidney, ureter and bladder surgery		6.7
Lumbar sympathectomy surgery	6	3.3
Appendectomies	3	7
Total	13	23.4
Grand total	30	100
Excluding appendectomy		

section of colon, jejunum and stomach in one stage resection for gastro-enteric fistula and gastrocolic fistula. In biliary tract surgery are included cholecystectomy (frequently a secondary operation) and plastic repair of the biliary duct. Large and small bowel surgery comprises one stage resections of the rectum resection for ulcerative colitis resection for carcinoma of the cecum resection for multiple enterocolic fistulas secondary to tuberculosis or typhoid fever resections for terminal or regional ileitis and plastic operations for malfunctioning entero-enterostomies.

In Group B under lower abdominal or pelvic organ surgery are included panhysterectomies removal of endometrial pathology plastic repair of vesicovaginal and vaginorectal fistulas, transvaginal hysterectomies and extensive combined perineal pelvic repair. Kidney ureter and bladder surgery comprises nephrectomies plastic surgery on kidney pelvis, and ureters and resection of bladder with transplantation of ureters. In sympathectomy surgery are included lower lumbar splanchnicectomies and ganglionectomies. Finally in this group are 3 appendectomies 2 appendices in which serious abdominal pathological conditions were anticipated, but no lesion was found.

## AGE AND DOSE

While no detailed record of age was charted the ages ranged from the second to the eighth decades of life. The average was in the usual cancer decades of the sixth and seventh. Age

TABLE II.—GRADE OF RISK

		Grade of risk				Total cases
		I	II	III	IV	
Group A	Ovarian surgery	1		41		
	Biliary tract surgery	1				16
	Large bowel surgery (except appendectomy)		12			33
	Small bowel surgery					
	Total	11	79	41		135
Group B	Pelvic organ surgery					23
	Kidney ureter and bladder surgery	6	6			
	Lumbar sympathectomies					
	Appendectomies					
Total			77			44
Total number in and B		17	106	41	1	165

influenced our dosage only as it affected the estimated grade of risk. The determining factors of dosage have already been mentioned earlier in this paper.

## RISK

As already published by Woodbridge "Every available item that might affect the ultimate outcome of anesthetics and of operation is considered in determining the operative risk that each patient presents. These include in addition to the other items, the age, vigor, degree of anemia, of dehydration, or of starvation, cardiac and respiratory reserve, diseases of liver, kidneys and metabolism, fever, length of confinement to bed, and prognosis of the surgical disease. Risk I means that no condition is known to be present that would affect the outcome unfavorably. Risk II means that some factor or factors of moderately unfavorable influence are present, whether they are part of the surgical disease or not. Such factors might be age of sixty years or beyond, a head cold or a moderate anemia. Risk III is a danger signal, and means that the patient is in such poor condition that any depressing form of anesthesia or any markedly shock-producing type of operation should be avoided if possible. Risk IV means that a fatal outcome may be expected."

The pre-operatively determined grade of risk occasionally influences our dosage usually to a small degree, i.e. by not more than 1

cubic centimeter of anesthetic solution Table II lists the grade of risk and is of considerable interest and an excellent index of the type of case in which this anesthetic agent was used

In group B there are no poor risk patients In group A, predominantly gastric surgery, there are very few patients listed as risk I, the majority are risks II and III and a few are risk IV The duration of anesthesia with a minimal depressive effect, characteristic of this dilution of nupercaine, lessens operative hazards in these serious risk patients

#### SUPPLEMENTARY ANESTHESIA

The usual indications for supplementary agents with spinal anesthesia are (1) an unsatisfactory choice of drug resulting in inadequate anesthesia, (2) a faulty technique resulting in insufficient length and height of anesthesia, or (3) inadequate pre-operative medication resulting in unpleasant responses during operation, such as mental anxiety, restlessness, discomfort outside the operative field, or idiosyncrasies resulting from medication This series of cases with nupercaine anesthesia tends to refute the first two assumptions concerning this drug and technique Table III lists the non-supplemented and supplemented cases of groups A and B

We wish to call attention to the very small percentage of supplemented cases in group B The majority of supplemented cases in group A were gastric resections of moderate to prolonged duration, in which undesirable reflexes to the operative procedures are frequent, even when actual pain is lacking

*Choice of drug* Rather than an unsatisfactory choice of drug, nupercaine is extremely satisfactory and is chiefly employed in those operations in which inhalation agents and methods might result in an injurious effect on metabolic functions or might interfere with the optimal surgical procedures, or in which other spinal anesthetic drugs are unsatisfactory either through insufficient duration of anesthesia or because of greater depressive effects Thus nupercaine facilitates operations which otherwise might be considered unwise to perform on poor risk patients

Supplementary anesthesia for insufficient duration of nupercaine spinal anesthesia was

TABLE III — SUPPLEMENTARY ANESTHESIA

Type of cases	Not supplemented	Supplemented	Per cent supplemented
Group A			
Gastric surgery	48	63	56.8
Biliary tract surgery	5	5	50
Large bowel surgery (except appendectomy)	9	4	30.8
Small bowel surgery	1	3	75
Total in Group A	63	75	54.3
Group B			
Pelvic organ surgery	15	6	28.6
Kidney, ureter and bladder surgery	9	3	25
Sympathectomies	6	0	0
Appendectomies	3	0	0
Total in Group B	33	9	21.4
Total in A and B	96	84	46.6

resorted to in 10 cases A résumé of these individual cases will be self-explanatory as regards the necessity of a supplement for motor relaxation (Table IV) The average duration of motor relaxation with the doses recommended in upper abdominal operations is from 3 to 3½ hours In lower abdominal operations the duration of anesthesia is frequently dependent on the total dosage of drug

*Technique* A faulty technique results in inadequate height or length of anesthesia Ninety per cent or 75 of the cases of nupercaine spinal anesthesia requiring supplementary anesthesia were in group A, and 84 per cent or 63 of these operations were major procedures of gastric surgery, chiefly resection The major portion of these supplemented cases is classified as insufficient height or length of anesthesia The desired anesthetic height in gastric surgery is between the second and fourth thoracic nerve segments Spinal anesthesia involving higher or more cephalad levels results in an increase in disturbance of respiration because of more extensive intercostal paralysis, a decidedly undesirable occurrence in any operation

To quote a previous paper (2) relating to this type of surgery, "In all operations of this type (gastric surgery) there are moderate to marked degrees of manipulation and traction on the stomach and esophagus with disturbance of the diaphragm and mediastinal structures Disturbance of these areas in a conscious patient results in a cycle of nausea and retching with associated drop in blood pressure



TABLE IV—CASE RÉSUMÉ. INSUFFICIENT DURATION OF ANESTHESIA

Sex	Age	Height	Duration of anesthesia (min)	Grade of risk	Operation	Duration of operation (min)	Supplementary agent	Why supplemented	Duration of supplemental agent (min)	Postoperative course of patient
F	20	5'	25	++	Gastric resection for duodenal ulcer	14	CO <sub>2</sub>	Discomfort and increasing muscle spasticity	14	Unfavorable
M	31	6'	30		Gastric resection for duodenal ulcer with obstruction	5	CO <sub>2</sub>	Muscle spasticity for abdominal closure	16	Unfavorable
M	43	5'	27	++	Resection of transverse colon, jejunum, and stomach for fistula	6	Proxipical ether	Mental anxiety. Much spasticity of abdomen	11	Unfavorable
F	64	Group B evaluation	1	++	Perineal repair and hysterectomy	10	CO <sub>2</sub>	Discomfort and abdominal spasticity	15	Good, short, primary pulmonary embolism
F	40	Group B			Perineal repair and hysterectomy		CO <sub>2</sub>	Discomfort and abdominal spasticity	14	Porting, later abdominal hysterectomy in later, recovered and an eventual
M	43	5'8"	30		Gastric resection for duodenal ulcer	1	CO <sub>2</sub>	Abdominal pain	5	Unfavorable
F	40	5'5"			Gastric resection for duodenal ulcer		CO <sub>2</sub>	Mental anxiety and abdominal discomfort	5	Unfavorable
M	26	5'	26		Circumcision of rectum, etc. and stage. Labry resection		CO <sub>2</sub>	Perineal discomfort	1	Unfavorable
M	38	5'6"	30		Gastric resection for duodenal ulcer	116	CO <sub>2</sub>	Mental anxiety. Abdominal spasticity		Less rapid
M	33	5'6"	30		Gastric resection for duodenal ulcer	154	CO <sub>2</sub> CO <sub>2</sub> + vent ether	Mental anxiety. Abdominal spasticity	14	Unfavorable

This cycle has two very undesirable results (1) It increases technical difficulties and may result in spilling of gastric or intestinal contents and (2) it results not only in considerable discomfort for the patient but also in

changes in vascular tone that might increase operative hazards. Therefore one must guard against extensive intercostal paralysis in crowded technical difficulties and mental or physical discomfort to the patient. It is with increasing frequency that we begin supplementary anesthesia for alleviation of sensory disturbance at the earliest indication. This quotation concisely summarizes the reason for the use of supplementary anesthesia in this group classified as insufficient height or depth of anesthesia.

TABLE V—INFLUENCE ON BLOOD PRESSURE

Cause of blood pressure fall		Not supplemented		Supple. mented		Total
Group A	Gastric surgery	24		18	19	31
	Uterine tract surgery					30
	Large bowel surgery (except appendectomy)		4	0	0	
	Small bowel surgery		0	0		
	Group A total cases	24	4	18	19	31
Group B	Perineal organ surgery	4	5	0	0	
	Kidney, ureters, and bladder surgery					
	Myasthenia					6
	Appendectomy					
	Group B total cases			5		6
Total cases Groups A and B		28	9	23	19	37

*Pre-operative medical on* Unsatisfactory pre-operative medication results in undesirable responses during operation. These responses or reactions are mental anxiety, mild delirium, restlessness, reactions of idiosyncratic or toxic manifestations, as nausea, retching, or vomiting changes in pulse, blood pressure, thermal changes and color. Pre-operative medication is an important factor influencing supplementary anesthesia. The 32 remaining supplemented cases are classified under reactions or responses mentioned



TABLE VII.—COMPLICATIONS OCCURRING IN CASES WITH 1:1000 DILUTION OF NUPERCARNE

Complications with recovery	Group A					Group B					Total Group A and B
	Gastric surgery	Biliary tract	Large bowel resection	Small bowel	Total Group A	Pelvic organs	Kidney, ureters, and bladder	Bronchi and lungs	Appendix	Total Group B	
Fyrtine											
Essential obstruction											
Total cases with complications											
Total number of cases			6		14	5	4			9	24

Remarks: (1) 14 of 38 cases, or 37 per cent, in group A. (2) 9 patients, or 25 per cent, developed complications. These complications were of no serious import, all recovered.

dosage has very little or no depressive effect on the cardiovascular system. Review of our cases demonstrates that when the changes in blood pressure occur they are usually sudden and marked, are associated with nausea and retching and appear to be initiated by manipulation of and traction on the abdominal contents, chiefly in upper abdominal operations.

For statistical purposes the changes are grouped in 4 classes. Class 1 includes those cases with no change in blood pressure; class 2 a drop of 25 per cent or less of the original systolic pressure taken previous to the spinal injection; class 3 a drop of from 25 to 50 per cent; class 4, a drop of from 50 to 75 per cent of the original systolic pressure. Table V entitled "The influence of nupercaine on blood pressure" is again divided into groups A and B, non supplemented and supplemented.

A considerable number of the cases in classes 3 and 4 fall in gastric surgery (compared with the other types of operation). The importance of the traction factor is demonstrated by the marked percentage difference in class 4 of supplemented and non supplemented cases: 20 per cent of the total in unsupplemented; 11 per cent of the total in supplemented cases, an indication of our previous statement as to the value of supplementary anesthesia for sensation outside the operative field. The large proportion of cases in class 3 among the supplemented cases in gastric operations is chiefly due to the fact that the supplement was not started until after the fall in blood pressure had been initiated. It is our impression that considerably less fall in blood pressure occurs when the supplement is started as soon as resection is decided upon by the surgeon.

In cases of sympathectomy the fall in blood pressure was influenced by the therapeutic effects from the operation rather than any untoward action of the anesthetic agent.

#### COMPLICATIONS

Complications occurring during anesthesia were rare and but 4 were recorded. They were cases of early sudden unconsciousness, as previously mentioned when the patient was placed in the initial prone position. Two patients were immediately turned to the supine position and the other 2 received small doses of the previously mentioned pitresin-ephedrine mixture. Recovery was immediate in all, and the course thereafter uneventful.

The source of our data for all postoperative complications is from the progress and discharge notes by members of either the surgical or the medical department. Minor complications might have escaped notation but every major complication occurring during the patient's stay in the hospital was recorded. We have included all listed complications, whether apparently caused by the operation or caused by the anesthesia.

The clearest, most concise and detailed methods of presenting these complications are first in relation to operation, second, in relation to risk and third, in relation to whether probably due to anesthesia or probably not due to anesthesia. At first glance the incidence of complications to total number of operations appears very high in both groups (Table VI). But one must stop and study the tables: the operations consist of major serious surgery on a group of poorer risk patients than one usually reports.

TABLE VIII—COMPLICATIONS OCCURRING IN CASES WITH 1:1500 SOLUTION BUT VARIED TECHNIQUE

Complications with fatal termination	Group A					Group B					Total Groups A and B
	Gastric surgery	Biliary tract	Large bowel	Small bowel	Total Group A	Pelvic organ	Kidney ureters and bladder	Sympathectomy	Appendectomy or hernia	Total Group B	
Pulmonary embolus	3				3					0	3
Bronchopneumonia	1	1			2					0	2
Gas gangrene		1			1					0	1
Hemorrhage	1				1					0	1
Failure from primary illness		1*			1					0	1
Total deaths	5	3	0	0	8	0	0	0	0	0	8
Complications with recovery											
Intestinal obstruction	1		2		3					0	3
Pyelonephritis	1				1					0	1
Total complications with recovery	2	0	2	0	4	0	0	0	0	0	4
Total cases with complications	7	3	2	0	12	0	0	0	0	0	12
Total number cases with 1:1500 plus other techniques	17	4	7	0	28	5	0	0	0	5	33

\* 4 hour operation

Remarks (1) 28 of 33 cases, or 85 per cent were in group A (2) 12 of 33, or 36.3 per cent, developed complications postoperatively (3) All the 12 patients were in group A (4) 8 of these patients, or 24.2 per cent, of the total of 33 patients died from complications

In considering all complications of nupercaine anesthesia we also include all the cases in which other solutions and technique were used (Tables VII and VIII)

*Complications in relation to risk* In Table IX we present the complications in relation to the pre-operatively evaluated grade of risk in those cases in which the recommended solution and technique were employed. Review of Table IX reveals (1) The morbidity and mortality are progressively increased in the more serious risk cases, as one would anticipate. This increase is marked in the ratio of mortality to morbidity percentages. (2) Due to the limited number of cases in grade 4 the results in this grade are of little statistical value.

*Complications in relation to anesthesia* In evaluating the influence of anesthesia as a causative factor in postoperative complications, we divide the complications into two main divisions: (1) those complications probably due to anesthesia, and (2) those complications probably not due to anesthesia. Table X charts this division. All complications when there is a question of causation are grouped as being caused by the anesthesia.

Examination of Table X reveals (1) 15 cases of 38 or 39.5 per cent of the complications were probably due to anesthesia, (2) of these 15 cases, 7 patients died, (3) 23 cases of 38, or 60.5 per cent, of the complications were not due to anesthesia, (4) of these 23 cases, 13 patients died, (5) peritonitis was the more frequent complication and has the highest mortality, (6) bronchopneumonia is next in frequency and mortality, (7) the incidence of pulmonary emboli and abscesses is higher than one usually encounters, (8) hyperthermia fol-

TABLE IX—COMPLICATIONS IN RELATION TO RISK WITH RECOMMENDED SOLUTION AND TECHNIQUE

Class of risk	I	II	III	IV	Total
Number of cases of each risk developing complications	3	23	11	1	38
Per cent of cases of each risk developing complications	11.5	21.7	24.4	33.3	
Number of complicated cases with fatal termination	1	11	8	0	20
Per cent of cases with fatal termination					
a. Total cases	4	10	17.5	0	
b. Complicated cases	33	47.8	72.7	0	
Total number of cases in each class	26	106	45	3	180

TABLE X.—COMPLICATIONS IN RELATION TO ANESTHESIA

Complications	Number dead	Number recovered	Total number
Complications with recommended solution and technique Probably due to anesthetic Breechpneumonia			
Pneumonia and sepsis			
Atelectasis			
Pulmonary embolus			
Pulmonary abscess			
Hyperthermia			
Postoperative psychosis			
Total		8	
Probably not due to anesthetic Peritonitis			
Intestinal obstruction			
Primary bowel (perforation)			
Pyelitis			
Hemorrhage			
Secondary abdominal abscess			
Emaciation, postoperative			
Wound rupture			
Dysuria			
Thrombophlebitis			
Thromboembolic process			
Total		10	
Total number risk recommended solution and technique	10	18	28
Complications with other methods Probably due to anesthetic Pulmonary embolus			
Breechpneumonia			
Progressive ischemia (12% heart apex thrombosis)			
Total			
Probably not due to anesthetic Intestinal obstruction			
Pyelitis			
Cat gangrene			
Hemorrhage, postoperative			
Pyelonephritis			
Total		10	
Total number with other methods			16

2 were of sufficient severity to be noted in the progress notes.

In summing up the incidence of complications in all 5 tables it is evident that the complications are chiefly the result of the operation and are influenced by the grade of risk rather than by the anesthetic agent or method. Without nupercaine spinal anesthesia it would have been extremely unwise to contemplate surgery of this severity on patients of these grades of risk.

#### SUMMARY AND CONCLUSIONS

1. The ease, simplicity and accurate determination of anesthetic levels with pontocaine-glucose technique recommend pontocaine as the agent of election in the majority of cases.

2. The use of nupercaine at the Lahey clinic is usually restricted to two general types of operations (a) those of anticipated prolonged duration and (b) those of positional importance.

3. (a) The prolonged anesthetic effect from very small doses of nupercaine is highly desirable in prolonged and extensive procedures on poor risk patients (b) in certain operations of positional importance a hypobaric solution is indicated rather than a hyperbaric solution.

4. Contrasted to the prevalent spinal anesthetic agents nupercaine is derived from a quinine nucleus.

5. The solution recommended is a 1:1500 dilution in 0.5 per cent sodium chloride.

6. As toxicity (W. H. Jones) is chiefly dependent on concentration the extreme dilution results in very little clinical evidence of toxicity.

7. The technique is Woodbridge's modification of the W. H. Jones technique. The dosage is governed chiefly by the sex and height of the patient.

8. Frequent early skin testing is an important factor in minimizing the occurrence of undesirable degrees of respiratory embarrassment if this does occur the use of oxygen is a valuable adjunct.

9. In the past, supplementary anesthesia was resorted to after the appearance of untoward effects at present supplementary anesthesia (a) is frequently resorted to early to suppress these effects.

lowing nupercaine is occasionally reported in the literature but in over 25 cases we have encountered but 1 case with the questionable diagnosis of hyperthermia (9) while there may have been more cases of atelectasis only

10 We have found pitressin-ephedrine mixture an excellent vasomotor stimulant to combat undesirable fall in blood pressure

11 The total number of cases with nupercaine anesthesia is 251, 180 with the recommended solution and technique. These 180 cases we report in detail, the remainder are mentioned in relation to complications

12 These 180 cases are subdivided into (a) group A or serious risk major operations of anticipated long duration, numbering 138, and (b) group B or operations in which the immediate position of the patient indicates a hypobaric solution

13 The majority of cases in group A are moderate to decidedly poor grades of risk, and the duration of anesthesia with a minimal depressive effect, characteristic of the nupercaine anesthesia, probably lessens operative hazards in these serious risk patients

14 Supplementary anesthesia is resorted to not because of an unsatisfactory drug or faulty technique but rather to lessen the technical surgical difficulties and to alleviate mental and physical discomfort to the patient

15 Nupercaine in the solution and dosage recommended has very little or no depressive effect on the cardiovascular system

16 Review of Tables VI to X, inclusive, demonstrates that the incidence of complications is chiefly dependent on the type of operation and grade of risk

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## REGIONAL FIBROCYSTIC DISEASE

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VON RECKLINGHAUSEN'S classical description of the pathology of generalized cystic changes in the human skeleton was published in 1891. The various diseases which he described in a single classification are now well differentiated entities. The clinical and pathological changes of localized fibrocystic disease are well understood but the etiology continues to be a subject for conjecture. Less commonly a type of fibrocystic disease may involve two or more bones and yet be confined to the same skeletal region or extremity. Rarely has this peculiar regional type of the disease been considered as a distinct entity in the description or the classification of the various types of fibrocystic disease.

A complete discussion of the nomenclature of this disease is given by Lichtenstein, who selected the descriptive term "polycystic fibrous dysplasia." Hodges, Phemister and Brunschwig, in 1936 first introduced into medical literature the term "regional fibrocystic disease." This appears to be entirely appropriate in a classification using the names "localized" and "generalized fibrocystic disease." Regional signifies that the disease is more extensive than "localized," yet that it is definitely limited to a certain portion of the body.

Ten cases which may be classified under this heading have been studied in the University of Chicago Clinics. The data which were obtained are summarized in Table I. Roentgenograms of the representative cases have been described in the legends.

### ANALYSIS OF STUDY

The age of onset is difficult to determine. There are reasons for believing that in many of the patients the lesions were present in infancy although the first symptoms or signs may not appear until late in life or not at all.

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In our series of patients the ages at the time of onset of first symptoms of the disease were as follows: Case 1, 4 years; Case 2, 13 years; Case 3, 11 years; Case 4, 34 years; Case 5, 10 years; Case 6, childhood; Case 7, 10 years; Case 8, 2 years; Case 9, "no symptoms"; Case 10, 7 years.

Six of our patients were males, 4 were females. This does not confirm the impression of Lichtenstein, who believed the disease was three times more common in females than in males.

Eight of our patients had definite symptoms resulting from the disease during childhood. In one patient the first symptoms appeared after maturity. In Case 9 there were no symptoms referable to his extensive lesions. The lesion in the ilium was noted on a roentgenogram of the abdomen which was made because of a gastro-intestinal complaint.

The bones most commonly involved in the 10 cases studied were the ilium and the femur. The frequency of involvement of the various bones was as follows: femur 8, ilium 7, tibia 5, humerus 3, ischium 3, pubis 2, radius 2, fibula 2, first metacarpal 1.

The distribution of the lesions in this series was as follows: Case 7, humerus, radius, first metacarpal; Case 1, humerus, radius; Case 6, humerus, ilium, ischium, pubis, femur, tibia, fibula; Case 2, ilium, ischium, pubis, femur, tibia; Case 4, ilium, ischium; Case 8, ilium, femur; Case 9, ilium, femur, tibia, fibula; Case 5, femur, tibia; Case 3, femur; Case 10, right and left ilium, right and left femurs, and left tibia.

In some cases there is a monomelic tendency as pointed out by Freund and Meffert. This is a segmental distribution with involvement of the humerus, radius and first metacarpal, but not the ulna or other metacarpals, as in Case 7 (Fig. 5). A similar segmental distribution is sometimes seen in the lower extremity. In Case 5, the femur and tibia were involved, while the fibula was normal. The roentgenograms of

these segmentally involved bones showed large irregular trabeculae in the fibrocystic areas of the proximal bone, while in the distal bones the cortex was thin and the trabeculae in the medulla diminished or absent (Fig 5)

In Case 6, the distribution was unilateral with involvement of the humerus, pelvis, femur, tibia, and fibula (Figs 2, 3, and 4) The lesion in the humerus, however, was small, circumscribed, and not typical of those commonly found in regional fibrocystic disease If this lesion alone were found, one might be justified in predicating a diagnosis of neurofibroma involving the bone, as has been described by Brooks and Lehman and by Hodges, Phemister, and Brunschwig Bilateral involvement without generalized skeletal changes was present in Case 10, while in each of the other 9 patients the lesions were limited to either the right or the left side

Borderline cases of fibrocystic disease may be difficult to classify A single bone cyst or localized fibrous lesion is readily recognized as the solitary type of disease Solitary lesions, however, may be progressive and, starting as a small focus, may eventually include more than one-half of the shaft of one of the long bones This progressive involvement was noted in Case A (Fig 10), which we have classified as a solitary rather than a regional type of the disease The cyst, which was at first a small lesion in the proximal metaphyseal portion of the humerus, became larger as length growth was added from this epiphysis The new bone formed in the proximal portion of the humerus showed the fibrocystic changes, accounting for the apparent progression of the fibrocystic disease Since this lesion involved only the portion of the diaphysis which was produced by the proximal epiphyseal plate and was essentially cystic instead of fibrous, it should be classified as a solitary type of fibrocystic disease

A second atypical case which we include for comparison is that labeled "B" in which there was a solitary lesion in the center of the femoral neck and a second in the shaft, just at the level of the lesser trochanter These lesions were found at operation to be separate cystic areas and the bone between them was apparently normal

*The etiology* of the localized and the regional fibrocystic disease is not known Pommer thought that small hemorrhages into the bone might give rise to a fibrocystic change with subsequent expansion of the lesion and perhaps cystic degeneration As pointed out by Freund and Meffert, trauma and hemorrhage are probably not primary etiological factors in the regional form Although multiple bone hemorrhages may occur in hemophilia, fibrocystic changes have not been observed in individuals suffering from this disease

Generalized osteitis fibrosa cystica is caused by an adenoma of a parathyroid gland, as was first demonstrated by Mandl, and confirmed at operation or necropsy in several hundred reported cases of this disease However, one of us (Compere) has previously reported that there is no biochemical evidence that either regional or localized fibrocystic disease is the result of disturbance in the mineral metabolism of the body as a whole It would not seem logical, in fact, to attribute localized or regional osseous changes to a generalized metabolic process

Lichtenstein believed that regional fibrocystic disease results from primary congenital factors This may account for the varied extent of the disease, the occasional segmental distribution, and the fact that it is frequently diagnosed in infancy or childhood and that it persists throughout life Some primary germ cell injury or defect may best explain all of these variants

That the localized bone cyst and regional fibrocystic disease are separate entities, although they have many features in common, would appear to be a justifiable conclusion There is little evidence that the localized lesion may progress to the regional form

The *symptoms* of regional fibrocystic disease rarely consist of more than a mild aching in the area involved and frequently this discomfort is not noted until after an injury Pathological fractures are common and malunion, delayed union, and refracture are frequent occurrences In the extensively involved lower extremity, progressive bowing may occur over a period of years (Case 10) As in Case 9 (Figs 8 and 9), symptoms of the disease may never appear



TABLE I—ANALYSIS OF CASES

Case No. Initials and sex of patient	Birth date Nationality Occupation	Bones examined	Summary of history	Kind of exam per cent
R. H. Male	Born 1866 American Bookkeeper	Left humerus Left radius	At age 1 year, he sustained fracture of the left radius and also just above the wrist. Fractured the shaft of the left radius at age 12 years, the lower left humerus at age 14, and the lower left humerus by sudden movement of the arm at age 22. First seen here at the time and diagnosis of fibro-cystic disease was made. All fractures healed without complications. At age 18 years he had an injury to lower radius, below the middle epiphysis. Rheumatism showed marked absorption of lower radius, including large portion of cortex. Bone and cementum revealed active young connective tissue. Three months later was shown dead as with new bone.	7-12-10 Ca P
P. W. Male	Not known	Left humerus Left radius Left pelvis Left tibia	At about the age of 12 years, after several fractures of the femur, affecting with one union occurred. The leg was amputated because the nature of the bone was such that it was not possible to save more than 10 inches and union of infection developed in the left pelvic region. 1 year later, from above part was obtained. The injury to the tibia was corrected. The pelvis was treated above knee and only the roentgenography and specimens were obtained for study.	
S. O. P. Female	Born at 1 American Student	Right femur (Page 22)	At age 12 years, patient fell, fracturing the right femur. The leg was splinted with splint for 4 months. Then, several places were applied and later removed after being accepted. At age 15 years patient had pain in the leg for day and the following day an abscess developed. Fracture of the femur while walking. She was in hospital for 1 month, then home for 1 year and was then sent to the University of Chicago. She died at the age of 16 years. Partial amputation of femur (lower third) was done. One year later patient had pain in the chest. Roentgenography showed incomplete fracture. A full chest x-ray showed fracture was placed across the fracture site. There has been no recurrence of symptoms.	10-1-10 P 1
R. O. Male	Born 1877 Irish Fireman	Left humerus Left radius	At age 22 years patient fell, fracturing left humerus and was disabled for 3 months. Followed fall at the age of 30 years, roentgenography showed an fracture had appeared, absorption disease of the left humerus and radius. Patient was young boy when fell, when he was 15 years of age, which caused pain, but no fracture.	
M. M. Female	Born 1888 Homemaker	Right femur Right tibia	Mild attack in the hip area about 10 years of age and in region of right tibia for 10 years. She was first seen in the clinic when 16 years of age. Roentgenography revealed fibro-cystic disease of the right femur and tibia.	
M. B. Female	Born 1891 Liberation	Left humerus Left radius Left tibia Left pelvis Left femur Left tibia Left tibia	During childhood, patient had many fractures of the left femur and tibia. These healed, but there was residual lateral bowing of the upper femur with absorption/shortening of radius. She was operated upon in 1911 and the right tibia and the right femur was used as graft in the tibia. The left tibia is covered and transplanted from the right tibia was inserted. There have been no fractures since operation.	1-12-10 Ca P 10-1-10 P 1
A. C. Male	Born 1890 American Student	Left humerus Left radius Left first metacarpal (Page 18)	At age 12 years of age, patient fell, fracturing the left and humerus. He was seen here 1 month later and the diagnosis of the humerus was corrected. No recurrence of symptoms.	1-12-10 Ca P 10-1-10 P 1
M. E. Female	Born 1891 Swedish Homemaker	Left femur Left tibia (Page 18)	At age 12 years, patient fractured left femur. Three fractures healed with moderate absorption below the upper part of the shaft. Two years of age patient began to have attacks of pain in the left leg. She was first seen here in 1911 and after correction of the fibrous material from the fractured third of the femur, some improvement in the tibia was reported. Last 10 years, years after the operation, she was young and free.	1-12-10 P 1
S. M. Male	Born 1891 American Bookkeeper	Right tibia Right femur Right tibia Right tibia Tibia and tibia	Somehow severe symptoms, began incidentally when roentgenography showed absorption was made. Died on 11 years and the bones of the tibia and femur were examined at autopsy.	1-12-10 P 1
T. L. Male	Born 1891 American Miner	Right tibia Left tibia Right femur Left femur Left tibia	Patient was first examined in the University of Chicago at the age of 12 years, during severe symptoms. Examination. He had had several fractures of both upper tibiae as low as he could reach above knee. Fall at the age of 12 years, he had suffered repeated attacks of pain in the left upper tibia. At the age of 12 years, he fell from horse and sustained fracture of the right tibia. The middle third of the shaft. Two fractures healed promptly and he was working hard for the next 10 years. He was injured severely and he was working hard for the next 10 years. Physical examination showed bowing of upper femurs and absorption of radius. He returned at age 16 years with complaint of pain in the right tibia. X-ray examination revealed an osteomyelitis in the right tibia, and the left tibia. The pain subsided after the use of transfer. Six months later, years later more bone was present, but the humerus had healed and he was working.	1-12-10 P 1

*Röntgenograms of regional fibrocystic disease* show expansion or the slight thinning of the cortex, marked irregularity in the density of varying portions of the shaft with frequent areas of decreased density which may be trabeculated. On the convex side of some of the bowed long bones, such as the femur, cortical defects suggesting incomplete fracture and similar to those described as *implantations* (6) may be noted (Case 10). Occasionally, most often in the radius or in the tibia, the lesion may present the appearance of extensive atrophy with paper thin cortices, absent or diminished medullary trabeculation, and a homogeneous appearance of the entire bone without the irregular zones of decreased density and the sclerotic septa. In the young or growing child, the epiphyses themselves are rarely involved. However, in Case 6, both the upper and lower femoral epiphyses show what appears to be a fibrocystic change (Figs. 2 and 3). This epiphyseal involvement may have occurred after closure of the epiphyseal plate had taken place.

*Chemical determinations* of the blood calcium and phosphorus and other laboratory tests in regional fibrocystic disease are normal. Freund and McFerrit and Lichtenstein reported that the phosphatase content of the blood was elevated in their cases. This is true in other non-related conditions in which there is hyperactivity of the bone-forming elements.

The gross pathological changes are similar to those of localized or generalized fibrocystic

disease. The cortex may be so thin that it can be cut with a knife, or it may appear grossly normal. The marrow spaces are wide and filled with firm yellow-white or gray fibrous tissue in which there may be small cavities containing fluid or gelatinous material (Fig. 11). The cyst-like areas which are noted in the roentgenograms may be found at operation or necropsy to be either true cysts or merely translucent areas which are filled with fibrous tissue.

*Microscopically*, regional fibrocystic disease can be differentiated from the solitary bone cyst but not from the *localized* discrete fibrous lesion (Fig. 11). The marrow and much of the cancellous bone may be found to be replaced with dense fibrous tissue. Throughout the fibrous tissue there are irregular trabeculae varying from markedly thickened and sclerotic bands to thin, widely separated, atrophic bone. Cement lines and osteoid tissue are commonly present, indicating that bone regeneration is occurring simultaneously with destruction. Most of this bone shows very irregular and abnormal calcification. The truly cystic cavities are usually lined with compact fibrous tissue. In Case 2, a microscopic section of the femur just distal to the site of non-union revealed an area of comparatively acellular fibrous tissue. A small central portion was cystic and surrounding the cystic area was an irregular wall containing abnormally calcified cartilage. No cartilage was found elsewhere in the tissue examined.



b  
Fig.

Fig. Case 5. a, b. This roentgenogram reveals solid union at the site where pathological fractures occurred 8 and 9 years previously. The cortex is thinned irregularly and expanded about the fracture site. The medullary region of the midportion of the shaft shows irregular trabeculation and areas of decreased density. 1, the subtrochanteric region and extending up to include the inferior half of the neck there is a cyst-like area of decreased density. 2, fibrotic trabeculae and surrounded by sclerotic wall. A similar lesion occupies the medial distal third of the shaft. 3, The femoral head, superior half of the neck, and the greater trochanter appear to be normal. c, A lateral view taken 4 years after partial osteotomy and 3 years after the insertion of bone graft. 4 shows the cortex is heavier the trabeculations are coarser and more numerous. There has been no recurrence of the fracture.

Fig. 2. Case 6. 1, the anterior superior portion of the left femur 4 and in the supra acetabular region there are cyst-like areas of decreased density. All of the left pubis and the iliac crest are composed of similar abnormal bone, 1, thick, distorted trabeculae. In the right ilium between the inferior portion of the neo-femoral joint and the acetabulum 2 there is an area devoid of trabeculae and surrounded by sclerotic wall. Multiple pathological fractures occurred in the right subtrochanteric region. These healed with gross deformity. The long y strut of bone from the neck of the femur to the shaft represents the fibular transplant which prevented subsequent fractures.

Fig. 3. Case 6. There is a cyst-like area in the distal portion of the left humerus 1, which is devoid of trabeculae and surrounded by sclerotic wall. The other bones of this extremity are normal.



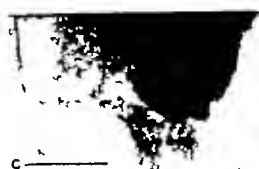
Fig 2



a



Fig 3



c

a

b

Fig 4

Fig 4 Case 6 The fibrocystic changes include the entire left femur, tibia and fibula The roentgenograms show irregular expansion of the diaphyses and irregular absorption of the cortices The medullary regions contain many rather large areas which are devoid of trabeculae The medullary bone between these areas is irregular and

sclerotic In the anterior portion of the tibia, crossing the junction of the middle and distal thirds, is a dense bone *a b* with normal trabecular pattern, representing bone transplant from the normal tibia to this region One cyst-like area extends into the region of the proximal tibial epiphysis *c*

(Legends for Figs 2 and 3 on opposite page)



Fig. 5. Case 7. a, left, The proximal half of diaphysis of the left humerus is expanded. The cortex is thin and the medullary region devoid of trabeculae. b, the distal half of the humerus the cortex is irregularly absorbed but not expanded. The medullary region contains 6 cyst like areas. The epiphyses are normal. A pathological fracture of the middle of the shaft 3 months earlier has completely healed. An operation was performed and the fibrocystic areas were curetted. Four years later roentgenogram showed that the fibrous areas had decreased in size and the bone about them was denser. The surgical defect was still present, surrounded by sclerotic bone. b, A frontal view of the forearm shows expansion of the proximal third of the radius. The cortex is thin and trabeculae are absent. There is slight involvement of the distal portion of the radial diaphysis b, but the mid portion of the radius and the epiphyses appear normal. Somewhat similar changes from normal may be noted in the diaphysis of the first metacarpal and in the base of the first phalanx of

About the cystic areas in Case 9 were loose fibrous tissue and nests of xanthoma or foam cells. Cortex of the ilium showed irregular hypertrophy. Much marrow was a normal hemopoietic type but in some areas replacement was by fibrous tissue and irregular trabeculae.



Fig. 6. Case 8. This roentgenogram demonstrates extensive fibrocystic changes of the left ilium and upper femur.

The differential diagnosis of regional fibrocystic disease is not difficult. The generalized fibrocystic disease involves most or all of the bones of the skeleton. The localized type is limited to one bone although there may be two or more localized lesions in the skeleton of the same individual. True osteomalacia, produced by dietary deficiency or glandular dysfunction is generalized. It is characterized by extreme atrophy in which cystic changes are uncommon. Neither localized nor regional fibrocystic disease is attended by changes in the calcium and phosphorus content of the blood or in the urinary output of these minerals. Osteitis deformans or Paget's disease may be either local, regional or relatively generalized. This disease occurs more often in elderly adults. The roentgenographic picture includes a thickened cortex and a narrow medullary region in contradistinction to the changes in regional fibrocystic disease. The calcium and phosphorus studies show a marked retention in contrast to the negative balance in hyperparathyroidism or generalized fibrocystic disease.

A biopsy and microscopic examination may be necessary definitely to exclude malignant or benign neoplastic disease.

The bone involvement in cases of neurofibromatosis may be similar to that of regional



Fig 7 Case 8 Extensive fibrocystic disease of femur a, before and, b, after operation and the reinforcement by means of a heavy tibial bone graft a b, and c, 2½ years later At site of most marked fusiform expansion of the femur c the cortex is markedly thinned there is moderate lateral bowing, and a break in the cortex indicates location of previous infraction f At operation only 2 or 3 small cysts were found, but much of the cancellous and cortical bone had been replaced by firm white fibrous tissue, which was widely excised before graft was inserted Marked improvement in roentgenographic appearance and strength of bone followed this operation

fibrocystic disease, but in this condition the brown, or *café-au-lait* skin pigmentation is usually present

Regional fibrocystic disease is frequently too extensive to attempt surgical eradication Treatment should be directed to the preservation of function Recurrent fractures may be prevented by the use of a massive inlay or onlay autogenous bone graft obtained from the tibia This procedure was carried out with satisfactory results in 3 of the cases which we are reporting (Cases 3, 6, and 8, Figs 1, 2,

and 7) Persistent aching in bones which show fibrocystic changes may be relieved by partial ostectomy and curettage, following which the defect should be filled with bone chips or a full thickness autogenous bone graft If the symptoms are vague or mild and no fracture impends, operations may not be indicated or justified In Case 10 pain localized to the region of an *umbauzone* was relieved following the use of crutches for about 4 months

The immobilization of pathological fractures through fibrocystic areas should be carried out



Fig. 8

Fig. 8. Case 9. The entire trabecular pattern of the right femur is abnormal. Moderate fibrocystic changes are shown in the neck of the right femur. An acetabulum is present.

Fig. 9. Case 9. a. The diaphysis of the right femur is not expanded or bowed. There is moderate regional endosteal absorption of the cortex. The medullary trabeculae are wide and irregular with many intervening areas of rarefaction. The distal epiphysis and small portion of the adjacent diaphysis is normal.

b. The diaphyses of the right tibia and fibula are irregularly expanded. The cortex is thinned. There are at least 6 fibrocystic areas of decreased density in the medulla, each surrounded by sclerotic bone. The roentgenographic changes in the fibula are similar to those present in the tibia.

Fig. Case 3. Localized fibrocystic disease shows late progression of the lesion. a, left. At age of 5 years the disease involved the upper 4 centimeters of the diaphysis. There was expansion of the shaft, thinning of the cortex, and irregular trabeculations. The epiphysis is normal. b. At the age of 8 years the disease involved more than half the diaphysis, even though there had been several fractures through the area and the lesion had been curetted twice. The upper half of the lesion is expanded, the cortex is thin, and the medullary region has numerous areas of decreased density. Its wide irregular trabeculae between them. This type of lesion may be confused with the regional fibrocystic disease.

Fig. Pathological studies in Case 9. a. Photograph of the femur after it is cut longitudinally. The epiphyseal regions of the head, greater trochanter and medially appear normal. The upper half and part of the lower half of the medulla are filled with yellow and gray fibrous tissue. The trabeculae in the fibrous areas are irregular and in some places are very coarse and bony. The cortex is pitted and sclerotic and in one area, just below the lesser trochanter it is expanded but mainly filled with fibrous tissue. b. Photograph of a microscopic section of the upper third of the femur. The epiphyseal regions of the greater trochanter and the head appear normal. Between these regions and the medulla is sclerotic all of bone (see in microscopic study). In the medulla the trabeculae are irregular and coarse. There are several small cysts in the medulla.



Fig. 9

On microscopic study the walls of these cysts are seen to be composed of degenerated fibrous tissue. In several regions near these cysts small nests of mast cells or foam cells are seen. The presence or meaning of these cells is not understood. Microscopic study of the all of bone separating normal marrow and fibrocystic disease. The marrow on the epiphyseal side is normal fatty marrow with occasional collections of hematopoietic cells. The trabeculae are normal or slightly hypertrophied. The bone on this side of the all separating the two regions is normal.

Like the bone on the other side is irregularly calcified, containing many cement lines and irregular in form. The marrow is replaced throughout the diseased portion by moderately cellular fibrous tissue. d. High power microscopic study of the fibrocystic disease shows the histology of the fibrous marrow. This is very vascular in some areas. An irregular bony trabecula is shown.



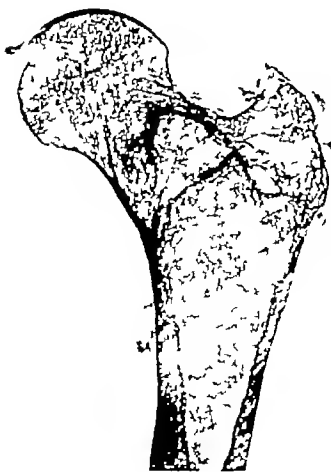
Fig 10



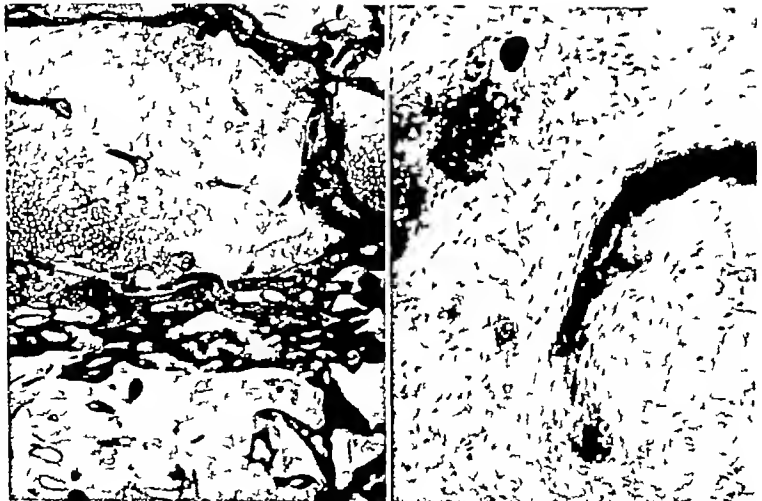
a

Fig 11

over a longer period of time than for fractures of normal bone and the return to full functional use should be delayed. There would seem to be no indication for the feeding of inorganic calcium, phosphorus, or other minerals, or of vitamin concentrates to a patient suffering from regional fibrocystic disease. These substances may be abundantly supplied in a well balanced diet.



b



c

d

Fig 11

(Legends for Figs 10 and 11 on opposite page)



## CONCLUSIONS

1. Regional fibrocystic disease is a clinical entity. It is similar to localized fibrocystic disease but the extent of involvement and differences in gross pathology differentiate the two diseases.

2. There is no difference in the sex incidence of regional fibrocystic disease. It is probably congenital in origin.

3. Symptoms usually begin in childhood. Pathological fracture is the most common symptom. Lateral bowing of the upper femur is the most common late deformity. Patients may have the disease over a period of many years without any symptoms being produced by the lesions.

4. Roentgen changes are typical and in most cases the differential diagnosis is readily made. The blood phosphatase level may be elevated but other known chemical or biological tests are not changed by the disease.

5. Treatment is limited to preservation of function and correction of deformities. Occasionally surgery is indicated for relief of pain.

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# STUDIES ON THE ILEOCECAL JUNCTION (ILEOCECUS)

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JUNCTIONS of two hollow viscera are constant sources of study and speculation in respect to their development, structure, and function, and the relationship of these subjects in turn to clinical manifestations. Three such junctions in the gastro-intestinal tract have been known as the cardia, the pylorus, and the ileocecal sphincter, respectively. In keeping with the nature of the first two words, and for brevity, we propose the name, "ileoecus," for the junction of the ileum with the cecum.

## EMBRYOLOGIC CONSIDERATIONS

Embryologically, the primordium of the ileocecal junction, the hindgut, is at first a straight tube (2). Later this junction of the ileum and colon forms a right angle. Connections of other parts of the gastro-intestinal tract remain throughout life as either a straight tube or a gradually curving tube. The anlage of the cecum, present in the 7 millimeter embryo, becomes so prominent in the 40 millimeter embryo that the intestinal tube forms a right angle at this point. The caudal portion of the intestine seems to be pushed around to a connection at right angles to the cephalic part of the tube. In early embryonic life, the large intestine is on the left side of the body cavity, with the ileum connecting to it from the right side (3). With subsequent growth, the cecum and colon revolve through a 180 degree arc around the long axis of the bowel, ending with the cecum situated in the right lower quadrant of the abdomen and the ileum connecting from the left. Keibel, basing his assertion on the work of Toldt, claimed that the bending of the vermiform process and cecum upon the colon incorpo-

rates the ileum in the angle, thus flattening the distal end of the ileum and producing the superior and inferior labia. The fact that the ileum does not increase in size as rapidly as does the large intestine, thereby exerting a stretching action on the opening of ileum horizontally, seems to us to be a more reasonable explanation of the flat labia frequently seen when the ileocecus is relaxed than the one of Toldt. The appearance of the relaxed ileocecal junction as a papillary eminence in early infancy further tends to substantiate this hypothesis.

## MUSCULAR STRUCTURE

One of us (Wesson) examined more than 50 human ileocecal junctions microscopically in multiple sections and with the aid of stains. These specimens covered the chronologic range between fetal life and advanced senility. Longitudinal sections were made of each labium. In every instance, the longitudinal muscle fibers were found to enter the labium for a considerable distance. In some instances, the circular muscle was found to be better developed than in others, but in no instance was an extracircular muscle noted, the existence of which in the structure concerned has been claimed by Rutherford.



Fig 1 Section through the ileocecal labium of a newborn infant, showing the longitudinal muscle extending well into the labium.

From the Division of Medicine and the Section on Proctology, the Mayo Clinic. A part of the material included here is an abridgment of a thesis submitted by Dr Harrison R Wesson to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery. Work done in the Department of Pathologic Anatomy and on the Intestinal Service, the Mayo Foundation, Rochester, Minnesota.

Dr Wesson now resides in Montclair, New Jersey.



Fig. 2. a, Lymphatic block at the ileocecal junction. b, longitudinal section through the gross specimen shown in a.

longitudinal section through the ileocecal junction of newborn infant. The junction as injected with solution of India ink and gelatin.

In some instances serial sections were made of the entire labium. These sections established the fact that the longitudinal muscle comprises a part of the labium across the entire width of the structure. By means of Lendrum's method a reconstruction of the ileocecal junction of a full term stillborn infant was made which demonstrated that the longitudinal muscle fibers enter the labium from both the ileal and the colonic sides and extend inward almost to the tip of the labium where there is a union of the two bands of fibers. In places an interlacing of the two longitudinal muscles seems to occur. These facts clearly demonstrate that the outer longitudinal band of the muscularis propria enters the superior and inferior labia of the ileocecal junction and together with the circular muscle and the muscle of the distal portion of the ileum, may well evolve into an anatomic structure possessing sphincteric action (Fig. 1).

#### LYMPH AND BLOOD SUPPLY

With a solution of 10 per cent gelatin blackened with India ink, and with thymol as



Fig. 3. Longitudinal section of specimen injected from the ileal side. Note the solution in the intermuscular spaces.

a preservative warmed to a thin liquid and kept warm in a warm water bath, and with this solution maintained at a pressure of 100 to 150 millimeters of mercury 15 specimens of the ileocecal coil taken from unembalmed cadavers were injected successfully in the lymphatic and submucous spaces.

Many other specimens were injected before methods and results were found to be satisfactory. It was noted that the solution flowed more rapidly when it was injected into the submucous spaces of the colon than when it was injected into the ileal side of the junction. On the side of the colon the solution flowed fairly uniformly up to the tip of the labia, at which point there was a definite block of the solution (Fig. 2a, b and c).

By a similar procedure the bowel was injected from the ileal side. The same type of block as was seen in the specimens injected from the side of the colon was noted (Fig. 3). A definite block to the free flow of tissue juices in the submucosa at the ileocecal junction is suggested by the preparations of India ink gelatin produced in postmortem specimens. The abrupt stoppage of the pigment in the presence of melanosis coli and the frequent limitation of a cancerous growth of the ileocecal junction to the cecal side is in keeping clinically with this observation.

The ileocecal artery, a branch of the superior mesenteric artery furnishes the blood supply for the terminal portion of the ileum, cecum and lower part of the ascending colon. There are cecal branches which run anteriorly and posteriorly over the cecum in the groove

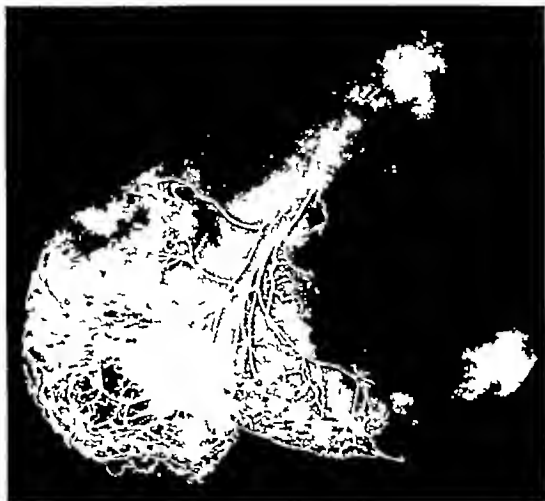


Fig 4 Roentgenogram of an ileocecus that has been injected with mercury

created by the junction of the ileum and cecum. As these branches cross, they also furnish small subserosal branches which extend medially over the ileum.

Specimens obtained at necropsy, including the proximal third of the ascending colon, the cecum, the terminal 10 centimeters of the ileum and the mesentery of this region which included the ileocecal artery, were collected. By suitable methods the ileocecal artery was injected with a solution of 4 per cent gelatin and India ink. The mesenteric branches of the ileocecal artery, extending medially to supply the ileum, were clamped and then by injecting the artery it was clearly demonstrated that there were subserosal vessels extending medially onto the ileum from the colon. Eventually, even the large ileac vessels filled with the solution, in spite of the fact that the ileac branches of the ileocolic artery were completely occluded (Fig 4). Just how the anastomosis occurs, whether through free submucosal anastomosis, or intermuscularly, was not demonstrated, but that there is adequate anastomosis in the labium is clear (Fig 5).

#### PHYSIOLOGICAL CONSIDERATIONS

The ileocecus seems to prevent the reflux of the content of the large intestine into the ileum (1). Also, it probably prevents too



Fig 5 Longitudinal section of the ileocecal labium after injection of the ileocolic artery, showing submucosal vessels on both sides of the labium

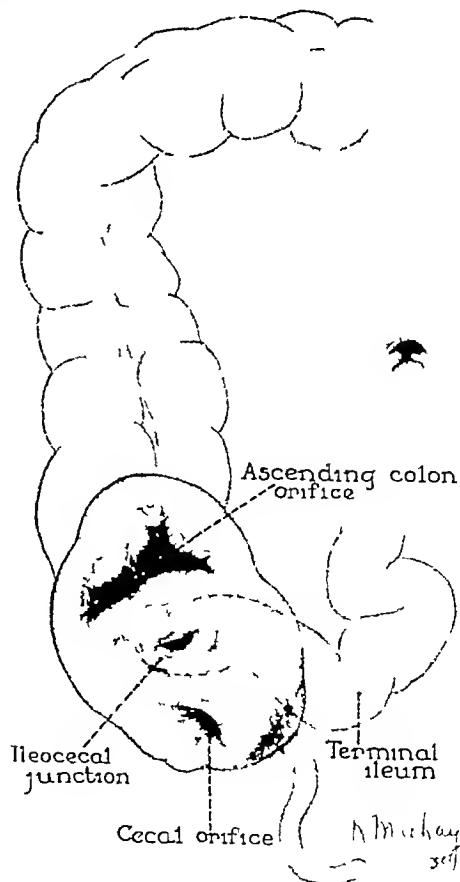


Fig 6 Schematic drawing of the exposed ileocecus Case 1



Fig 7



Fig 8



Fig 9

Fig 7 Kymographic tracing of the contraction of the ileocecal sphincteric structure and its failure to respond after rapid, repeated stimulations. The initial spasm is caused by insertion of the finger in the colon for period of 6 seconds. One centimeter equals 1000 in time. Case

Fig 8 Kymographic tracing illustrating the relaxation of the sphincteric structure following injection of 8 milligrams of epinephrine intramuscularly. Case

Fig 9 The effect of injecting 50 milligrams of acetylcholine intramuscularly. Relaxation of the sphincteric structure is followed by contraction, Case 1.

rapid a passage of intestinal content from the ileum into the colon (9). Movements of this region in the intestine are small and slow.

Opportunity to make observations directly on the living human ileocecus seems to be a rare privilege. We have found records of 4 instances in which such observations were made. MacCawen, Rutherford, Short, and White, Rainey, Monaghan and Harris have made observations on the human being in the years 1904, 1914, 1919, and 1934 respectively. They observed an increased activity of the terminal portion of the ileum from the cecal side and of the ileocecus, occasional rhythmic contractions of the terminal portion of the ileum and change in tone of the muscle and relaxation of the ileocecus following the injection of epinephrine.

We wish to record studies on the exposed ileocecus of two women who volunteered to co-operate in the investigation. In both in-

stances, the patients came under our care months after cecostomy had been performed and after the intestine had assumed its normal motility.

#### REPORT OF CASES

CASE. The first patient was female, aged 55. She had had cecostomy performed elsewhere for a obstruction of the descending colon. Prolapse of the cecum had occurred, so that the structure protruded in the everted position about 5 centimeters beyond the anterior abdominal wall. The oval mass thus produced measured by 7 by 5 centimeters, and presented three openings: (1) an inferior one at the halo-rectal pouch, (2) small ileal opening, and (3) large superior opening leading into the ascending colon (Fig. 6).

The small ileal opening admitted the index finger without causing any pain. The ileocecal structure as relaxed most of the time especially when the patient lying quietly in bed. Periods of 30 to 60 minutes could elapse without action in the sphincteric structure during which time there would be no passage of ileal content. When the

tissues of the ileocecal junction were relaxed, the structure appeared as a slit-like orifice with its superior and inferior labia, which is similar to the junctions as they are seen at necropsy, but when the musculature contracted, which it did periodically, its shape was a mammillary eminence with an opening in its summit.

The eating of food greatly increased activity in this region and soon ileal content could be seen to appear in small jets. With the onset of any activity in this region, the ileocecus contracted, then gradual relaxation and the passage of the ileal content followed. A small amount of barium suspension was administered to the patient by mouth and it appeared at the ileocecal opening in  $4\frac{1}{2}$  hours. When the finger was inserted into the ileal opening, it was gripped by a definite muscular sphincter. This muscular band was situated about 3 centimeters from the dome of the mammillary eminence. White and associates recorded a similar observation.

The insertion of a finger proved to be the best method of stimulating this sphincter-like contraction. Inserting the finger into either the cecal or the colonic orifice produced a similar contraction of the ileocecus. After stimulating the ileocecus to contraction, it was not possible to insert the finger into the contracted ileocecus until it relaxed, this action required from 1 to 2 minutes.

Efforts were made to record some of these contractions. The apparatus used consisted of a rubber balloon, a writing lever on a rubber tambour, and a kymograph. The balloon was made of light rubber and was tied over a hollow glass tubing which had been perforated along its sides and closed distally. There were two cuffs of glass on the tube, one at the closed distal end, the other 5 centimeters away, just above the perforation, which helped to maintain the balloon in its desired position. A mechanical stimulus with the finger in the colon for 5 seconds resulted in an initial abrupt rise of the writing lever, caused by pressure on the balloon by the inserted finger, this was followed by a true record of the contraction of the ileocecus (Fig. 7).

After 4 stimulations in sequence, the response of the ileocecus was much shorter and less effective, suggesting evidence of fatigue. Injection of 0.8 milligram of epinephrine resulted in prompt relaxation of the sphincter-like mechanism, this relaxation was maintained for more than 30 minutes (Fig. 8). Ten milligrams of acetylcholine was injected intramuscularly, resulting in prompt decrease in the tone of the muscular structure, followed in about 25 minutes by a gradual increase in the tone (Fig. 9).

Although the patient was entirely co-operative during our investigations, records obtained when other drugs were used were unsatisfactory. For instance, following the injection of physostigmine there was a reaction characterized by sweating, nausea, and vomiting, so that results could not be recorded.

**CASE 2** The second patient was also a woman, aged 45, who had had cecostomy performed elsewhere in an attempt to relieve severe ulcerative



Fig. 10. Left, Sphincteric action in the ileocecus when a rubber catheter is inserted, right, activity of the ileocecus when it is stimulated with a pair of forceps. Case 2.

colitis of the descending colon. All the gross observations made concerning the first patient were substantiated in examining the second, so far as mechanical stimulation, appearance, and motility were concerned. The motor activities of the ileocecus of the second patient have been recorded cinematographically. At the time we encountered her, the main complaint was herniation of the bowel at the cecal stoma, as well as continued bloody rectal discharges.

The size of the prolapse was approximately 12 by 12 by 10 centimeters. The terminal portion of the ileum, with the ileocecal eminence at the distal end, projected at various times from 6 to 10 centimeters above the surface of the abdominal wall. This variation in the degree of projection of the ileocecus and terminal portion of the ileum above the abdominal wall seemingly would be caused by the state of its activity.

If the patient was lying quietly and relaxed and if no stimulus was applied to the region, the terminal portion of the ileum and the ileocecus would appear to be flaccid and relaxed, with a partially patent opening which extended about 6 centimeters above the surface of the abdominal wall. It was extremely fascinating to observe the effect of stimulus such as the attempted insertion of a catheter or a hemostat through the sphincteric structure (Fig. 10, a and b). The terminal portion of the ileum and the sphincter-like mechanism would become turgid and rise 3 to 4 centimeters above their usual positions in a relaxed state, and the patent ileocecus would become tightly closed, after insertion of the hemostat and a gentle spreading apart of the blades in order to open the "sphincter," the region would offer some resistance. The normal pink, overlying mucosa would first become a dark red, changing gradually with continued application of the stimulus to a dusky blue-red, with a band of pallor overlying the region of the ileocecus. If the stimulus was not withdrawn, after 30 to 60 seconds the portion would go back into its relaxed state.

Such stimulus caused the patient little pain. The irritability or the response to stimuli also varied considerably, being definitely more marked after food or water was taken into the stomach.

We had hoped to record this interesting phenomenon on the motion picture film which was made just

prior to the patient's going to surgical treatment for the relief of prolapse. She had been fasting for about 16 hours previously and much to our dismay the patient refused to perform except very feebly in spite of all mechanical stimuli. After the pre-operative administration of  $\frac{1}{100}$  grala (0.00005 gr.) of tropine and  $\frac{1}{2}$  grain (0.032 gr.) of morphine the patient seemed to go into tetanic state and little or no response to stimuli occurred.

After the administration of the spinal anesthetic, the ileocecus became entirely relaxed and failed to respond at all. On surgical exploration, the prolapse was found to be so marked that local repair seemed inadvisable hence the ileocecal coil was resected and ileocolostomy was performed.

#### SUMMARY

An embryologic review and an anatomical study of the musculature blood and lymphatic supply of the ileocecal junction of man have been made. The function of this junction has been studied and clinical observations concerning two human beings have been recorded.

It has been demonstrated that in man the circular and longitudinal muscles of both the ileum and colon enter the labia of the ileocecal junction comprising a structure with sphincteric action. Stimulation of this region in the human being with resulting contraction and relaxation suggests that its function is concerned with the production of a barrier between the ileum and the colon when such a barrier is needed.

There is a lymphatic block at the tip of the labia of the ileocecal junction. The clinical significance of this has been discussed.

Abundant blood supply and extensive anastomosis of blood vessels in the labia of the ileocecal junction have been demonstrated.

The designation of ileocecus has been suggested for the ileocecal junction.

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# CHOLEDOCHAL DENERVATION

## A New Procedure for the Relief of Biliary Dyskinesia

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PRIMARY operations on the gall bladder, as performed today, are attended by gratifying results in the great majority of cases. This is especially true when the gall bladder contains stones and the remainder of the biliary tract is free of pathological conditions. However, all of us have seen patients with typical biliary colic history and x-ray diagnosis of impaired gall-bladder function without calculi, who show but little gross pathology at the operating table, and in these cases the usual cholecystectomy may not give the desired good result. This group of patients, and a small percentage of those who had real pathological gall bladders, experience a postoperative course most disturbing to the surgeon who sees them in the follow-up clinic, for they persist in having symptoms reminiscent of their pre-operative days.

In recent years the syndrome known as biliary dyskinesia has received considerable attention. Most of the investigators believe that spasm of the sphincter of Oddi is the underlying factor and that such spasm or hypertonicity by itself can give all the symptoms of a biliary colic. Best and Hicken state that physiological evidence indicates that the choledochal duodenal sphincteric mechanism has sufficient contractile force to prevent flow of bile into the duodenum, thereby increasing intraductal pressure. Carter, Greene, and Twiss believe that "the mechanism of biliary dyskinesia does not produce an absolute obstruction of the common duct, but rather a partial and intermittent obstructing influence on the sphincteric mechanism of the common duct." The etiological factors relating to this condition, important though they may be, are not the concern of this report, but rather are we interested in the means of abolishing this spasm.

Biliary dyskinesia can be ameliorated by the administration of atropine or nitroglycerine, or by the intraduodenal instillation of magnesium sulphate. These drugs are definite in their action and certainly do give relief, but such relief is frequently only temporary, and recurrences are not prevented. Surgically, this problem has been attacked in a number of ways. In order to avoid the sphincter entirely, the bile has been diverted into the intestinal tract by means of a choledochoduodenostomy. Another method has been the forced dilatation of the papilla of Vater by means of bougies inserted through a choledochostomy. The permanence of this dilatation has been questioned, and the recent experiments of Zollinger suggest that injury to the common duct may occur with subsequent scarring, ultimately resulting in a smaller opening than originally existed. Colp and Doubilet utilized the procedure of endocholedochal sphincterotomy. They devised an instrument called the sphincterotome which they insert into a choledochostomy and cut and remove a segment of the sphincter. In their one case which they reported in May, 1938, the postoperative kymographic records show that the resistance of the sphincter has been markedly diminished by this sphincterotomy.

We believe that there is a genuine need for a procedure which will permanently relax or obliterate the function of the sphincter of Oddi and it occurred to us that an interruption of the nerve supply to the sphincter might accomplish this, if such nerve or nerves could be isolated. The literature does not describe any definite nerve supply of the sphincter. Gray's *Anatomy* states that the nerves to the gall bladder and ducts are derived from the celiac plexus of the sympathetic chain. The branches of the right semilunar ganglion are shown following the course of the hepatic artery, some



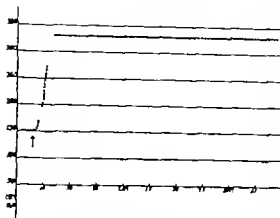


Chart. Effect of morphine upon the intraductal pressure in patient with intact choledochal sphincter mechanism. Morphine sulphate, 1 grain, given subcutaneously at arrow causes spasm of sphincter which persists for over 4 hours.

fibers crossing in front of the portal vein ascending the common duct to the gall bladder but there is no mention of an innervation of the sphincter. Kuntz, in his book *The Autonomic Nervous System* makes no mention of the nerve supply of the sphincter. Carter states that the gall bladder is under the control of the nervous system—that the vagus is probably motor in character while the splanchnics are inhibitory. They believe that the duodenum and sphincter of Oddi are likewise subject to such nervous regulation, but they make no mention of how the sphincter receives such nerve supply. Oddi described special ganglia in the region of the sphincter and believed that it could be affected reflexly by stimulation of other parts of the gastrointestinal tract. Others (2 and 8) have noted changes in the tone of the sphincter by irritating gastric mucosa or applying drugs directly to the papilla of Vater but there is no description of the exact nervous mechanism involved. Goldman and Ivy have shown that the hepatic nerves in some way regulate the bile secretion and that section of these nerves is followed by an increase in the flow of bile from the liver but no mention is made of the effect these nerves have upon the tonus of the sphincter.

In order to satisfy ourselves that there is a distinct nerve which may supply the sphinc-

ter we performed cadaver dissections. The common duct was easily separated from the hepatic artery and the hepatic plexus of nerves isolated. In following the branches of the hepatic plexus, a nerve was seen running horizontally behind the hepatic artery approaching the common duct at its distal portion just about where it passes behind the duodenum and directly above the superior margin of the head of the pancreas. Other nerves were seen surrounding the hepatic artery ascending to supply the upper portion of the biliary tract, but the branch just described was the lowest observed to enter the duct. In some cases, pancreatic tissue partially enveloped this nerve. If this nerve actually supplied the sphincter sectioning of it might result in a paralysis of the sphincter with a marked drop in the resistance offered to the outflow of bile. Having demonstrated to ourselves that the approach to this nerve was surgically possible we determined to excise a portion of it in the next patient upon whom we had to perform a choledochostomy in order to investigate the results which might follow such a procedure.

Our patient, a 41-year-old female aged 40 years, had had a history of chronic indigestion for years with occasional severe attacks of biliary colic, but no jaundice. X-ray examination showed chronic cholecystitis. At the operation, dissections were found between the gall bladder and the duodenum and several small calculi were felt in the ampulla of the gall bladder. Cholecystectomy was performed in the usual manner. No stones were felt in the common duct, but because it was thickened aspiration was done. A gritty turbid bile was obtained and therefore the common duct was incised and T-tube lith very soon removed and red into the open gall bladder. A calibrated papet filled with saline solution was then attached to the T-tube and the resistance of the sphincter of Oddi to this column of fluid was measured. Repeated readings showed the lowest resistance offered by the sphincter to be 1.5 mm. Hg. The papet was then disconnected and by exerting little traction on the T-tube the lower half of the common duct was well outlined. Blunt pointed scissors were used to incise the gastrohepatic omentum between the common duct and the hepatic artery thus separating the two structures. By retraction of the duct laterally and the artery medially, branches of the hepatic plexus were exposed; they ran behind the hepatic artery. The lowest nerve exposed entered the common duct directly above the head of the pancreas. This nerve sectioned at its entrance into the wall of the duct

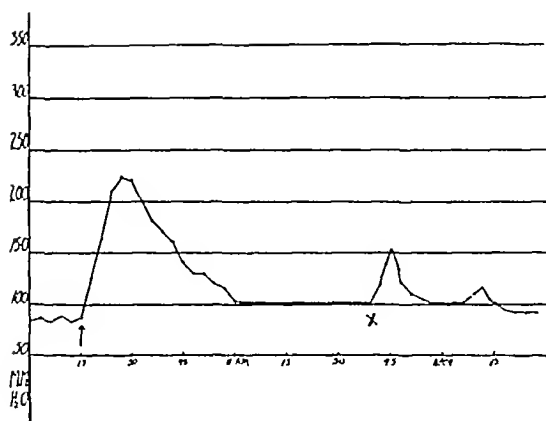


Chart 2 Effect of morphine upon intraductal pressure after denervation of the common duct. Morphine sulphate,  $\frac{1}{4}$  grain, given subcutaneously, at arrow, produces a rise in pressure which is not maintained. The psychic effect of the sight of food is shown at x.

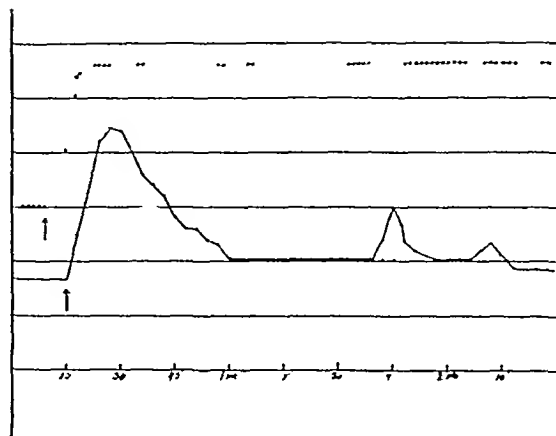


Chart 3 Chart 2 superimposed upon Chart 1, thus illustrating the different effect that morphine has upon the intraductal pressure in the intact choledochal sphincter mechanism (—) and upon the denervated common duct (---).

and a small portion was excised and sent to the laboratory (Histological examination showed this to be nerve tissue). A ligature carrier was then placed behind the common duct from within outward and run up and down for a short distance, in this manner severing some of the nerve supply of the distal half of the duct. Traction on the duct was then released, but no sutures were placed in the gastrohepatic omentum. The pipette was attached to the T tube and measurements were again taken. Repeated readings showed the resistance to be 40 to 50 millimeters lower than it had been prior to the excision of the nerve. If this drop in the resistance is interpreted as being due to a loss of sphincter tone, then the residual intraductal pressure of approximately 80 millimeters must be due to the tonus of the duodenal musculature which surrounds the terminal portion of the duct.

Experiments in the past few years (7) have definitely established the fact that the subcutaneous injection of morphine sulphate increases the intraductal pressure markedly, and the spasm of the sphincter of Oddi, which is the cause of the increased pressure, is maintained for 2 to 3 hours (Chart 1). If, by our procedure, we have impaired the function of the sphincter, the administration of morphine to our patient should have no such effect.

On the tenth post-operative day, therefore, measurements of the intraductal pressure were again taken. This pressure was found to be equal to a column of saline solution 85 millimeters above the level of the common duct and for about a half hour the variation was no more than 10 millimeters. The

patient was then given morphine sulphate,  $\frac{1}{4}$  grain, subcutaneously and within  $2\frac{1}{2}$  minutes the intraductal pressure began to rise. This rise was steady and continuous for about 9 minutes when it reached a maximum height of 220 millimeters. This was maintained for about 6 minutes and then a slow but steady fall ensued, occasionally interrupted by slight rises in pressure. Within 45 minutes from the time of the injection the intraductal pressure was about 100 millimeters, almost back to the base line. About 40 minutes later dinner was served to her neighbor and the sight of food caused an immediate rise in pressure to 160 millimeters, and it took almost 10 minutes to return to normal. There was another similar though smaller rise in pressure when she was served her tray. As she ate her food the pressure dropped to the base line and stayed there for the remainder of the experiment (Chart 2).

The significance of this reaction is appreciated when Chart 3 is examined. In the patient with the intact sphincter mechanism morphine causes a precipitate rise in intraductal pressure which is maintained continuously for  $2\frac{1}{2}$  hours. In our patient morphine also caused a rise in pressure, which was just as precipitate but not as high, and certainly not maintained for any great length of time. If our contention is correct, that the function of the sphincter has been impaired by interrupting its nerve supply, we must ascribe the rise in pressure entirely to the response of the duodenum to the morphine.

In order to determine the reaction of the duodenum to morphine, we performed the

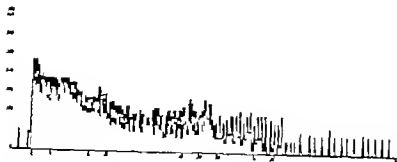


Chart 4. The effect of morphine sulphate upon the duodenum. There is no great increase in the amplitude of contraction, but the rate of contraction and the tone of the musculature is increased. The effect of morphine is entirely gone after about 30 minutes.



Chart 5. The effect of high morphine dose upon the intact choledochal sphincter mechanism ( ), the denervated common duct ( ) and the normal duodenum. It is clearly seen that the rise in intraduodenal pressure in the denervated common duct closely parallels the changes in intraduodenal pressure, whereas in the patient with the intact sphincter mechanism, prolonged spasm is produced.

following experiment on a male adult recuperating from a fractured femur. We attempted this procedure on our patient, but she could not tolerate the tube.

A Miller Abbott tube was passed and allowed to reach the middle of the duodenum. Its position in the duodenum was checked by the fluoroscope, the balloon was inflated with 35 cubic centimeters of air and the open end of the tube was attached to a water manometer. The sudden inflation of the tube stimulated marked contractions of the duodenum for a few minutes, but thereafter the duodenum became quiescent, contracting about times per minute. Morphine sulphate,  $\frac{1}{2}$  grain, was then given subcutaneously. Within minutes the duodenum began to react and the intraduodenal pressure forced the water in the manometer to rise almost 50 millimeters (Chart 4). However there was no spasm of the duodenal musculature but repeated alternating contractions and relaxations, about 6 per minute. This high intraduodenal pressure was not maintained very long, and after few minutes slow

steady fall ensued. About 30 minutes later the number of contractions per minute decreased and the pressure, and after 35 minutes the effect of the morphine appeared to have disappeared entirely.

The important thing to note in this experiment is that for about 8 to 10 minutes the tone of the duodenal musculature remained increased, so that the lowest intraduodenal pressure recorded was 100 to 150 millimeters above the base line. Thereafter the tone gradually lessened, until it reached the base line about 30 minutes after the administration of morphine, and remained so for the duration of the experiment. This procedure was repeated upon another normal individual and an approximately similar curve was obtained.

Chart 5 shows the effect of morphine sulphate on the intact choledochal sphincter mechanism; the denervated sphincter mech-

anism, and the duodenum. It is readily seen that when the sphincter is deprived of its innervation, it apparently has no power to respond to morphine, and the rise in intraductal pressure is probably the direct result of the active duodenal musculature.

#### SUMMARY AND CONCLUSIONS

In presenting this report we are only too well aware of the fact that the result obtained in 1 case is not positive confirmation of the value of any new procedure. However, since the findings were consistent with our theory it seemed well to publish our observations.

1. The pressure within the common duct is partially controlled by the tonus of the duodenum, but the sphincter of Oddi apparently is capable of functioning independently.

2. Morphine sulphate appears to affect the musculature of the duodenum differently than it does the muscle of the sphincter.

3. The possibility should be entertained, therefore, that denervation of the common duct, or excision of the lowermost nerves supplying the duct, may affect the function of the sphincter, thereby relieving biliary dyskinesia.

At this time it may be a little premature, but if further experiments bear out these

facts, we offer the suggestion that perhaps this procedure should not be limited to the occasional case of true biliary dyskinesia, but should be carried out, whenever technically possible, in all cholecystectomies, so that some of the unpleasant postoperative complaints may be avoided.

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## CANCER OF THE OVARY

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TWO similar articles have been previously written by the author on cancer of the ovary, one was published in the *Southern Medical Journal* (4) for February 1937 and reviewed the cases at the Massachusetts General Hospital from 1901 to 1931 the second in the *New England Journal of Medicine* for March 1939 (5) which carried the review through to 1933. This report brings the series through June 1934 a period of 34 years. The outlook for patients with ovarian cancer is very poor and for that reason it seems wise to emphasize to surgeons the desirability of earlier diagnosis and more radical treatment. Lynch's paper and the author's first report published at about the same time give results nearly alike. It is obvious that as the Massachusetts General Hospital series increases in size the prognosis of cancer of the ovary does not improve. In the first series 20 patients were living out of 135 about 14.8 per cent. In the second series there were 24 living out of 147 or 16 per cent and in the third series (that is, the present series) 25 patients are living out of 154, or 15.5 per cent. The results are discouraging and are worse than most reports on groups of other types of cancer. Carcinoma of the body of the uterus, carcinoma of the cervix, and carcinoma of the breasts all do better. Even carcinoma of the vulva has a better prognosis than carcinoma of the ovary. There is no doubt that if all patients that had any suspicion of a tumor of the ovary were operated upon immediately if peritoneoscopy were employed for diagnosis, and if pelvic examination could be more accurate early diagnosis and early operation would markedly improve the end-results.

### MATERIAL

This study is a survey of 154 patients who have been seen and operated upon at the Massachusetts General Hospital from 1901 through June 1934. All ovarian tumors and papillary cysts, not only malignant ones, were grouped together all microscopic slides were

reviewed by the author and all benign lesions were discarded. It was necessary to ask Dr. Tracy B. Mallory, our hospital pathologist, to settle the question of malignancy or benignancy on numerous occasions, especially in the group of papillary cysts. All odd tumors were excluded from this series that is, all granulosa cell tumors, Brenner tumors, arrhenoblastomas, dysgerminomas, Krukenberg tumors, teratomas, etc. were discarded. Frequently it was a great question what sort of a tumor a particular slide represented and if there was any suspicion that it was of the endocrine type, it was excluded from the series. No metastatic lesions in the ovary from the uterus, the cervix, or the intestinal tract were included. All Krukenberg tumors were omitted. If a given biopsy specimen from a small area removed from the abdominal cavity, peritoneum or omentum looked like ovarian tissue to the pathologist but the surgeon could not definitely state its origin the case was discarded. If there was generalized abdominal carcinomatosis but it did not seem of definite ovarian origin to the surgeon the case was excluded. This is not a very large group of cases, but by its exclusion of benign types of carcinoma—such as the highly specialized endocrine type—and metastatic lesions, it is a true group of primary epithelial carcinomas. If a tumor previously considered microscopically malignant did not seem so to the reviewer and the patient was still living the case was excluded. Knowledge of the patient's history, the operative findings, end-result, and the microscopic study of each tumor was the aim of the author. This should be essential in all reports of malignant disease. The hospital record room files are not sufficient in themselves. The microscopic slide must be reviewed, and if it is lost, the case should be excluded from any report. Misinterpretation in the laboratory without clinical knowledge is easy. The slide must be reviewed along with the history, operative findings, and the end results. There were certain tumors of the pseudo-

mucinous type with generalized peritoneal implantations. If implantations they are not due to lymphatic extension but are attached to the peritoneal surface by organized granulation tissue, as demonstrated by Dr. John Sampson some years ago. These tumors, if the patient were alive more than 5 years, and if the tumor did not appear to be malignant microscopically, were excluded from this group. Dermoid cysts and teratomas develop in the ovary, from an epithelial cell in such an embryonal development a malignant ovarian tumor may arise. If there are any areas in a tumor suggesting dermoid cyst or teratoma it cannot be classified as a primary epithelial growth of the ovary. Care must be taken to cut numerous sections of all ovarian tumors to exclude its origin from a dermoid or from a teratoma. Carcinomas arising in either act differently from primary epithelial carcinomas of the ovary. Sarcomas develop in the connective tissue of the ovary and must be excluded. There is no doubt that with increasing knowledge there will be found tumors of specialized function in the group of tumors analyzed here. As functioning tumors are less malignant they will probably be found among the survivors.

#### EMBRYOLOGY OF THE OVARY

Because so many tumors of the ovary are different in their histological characteristics, and because it is obvious that many are embryonic in their type, it is essential to present a short description of the embryology of this organ. The ovary arises as a mass of mesenchyme on the back wall of the abdominal cavity of the embryo. Epithelium from the pelvic or celomic epithelium surrounds this mass. The ova are believed to arise from this surrounding epithelium in one theory and in another from the hind gut, and migrate into the mass. The connective tissue surrounding the ova becomes highly specialized and is the source of the granulosa and thecal cells of the follicles. Therefore, in the depth of the embryonal ovary and arising from connective tissue, are structures that can and do look like epithelial tissue, thus the lining of follicle cysts which arise from granulosa cells is certainly epithelial in its appearance, yet

the origin is not epithelial. It is possible that the primordial ova present in the young ovary are not the ones that develop into mature ones. It is thought in some research departments that ova can originate from the epithelial covering of the ovary in adult life.

Some consider the very early gonad neither ovarian nor testicular but that its development depends upon whether or not its germ cells are spermatazoa or ova. It is conceivable therefore that certain cells that might have been testicular are present in the ovary even without spermatazoa, and if so, are the origin of the male endocrine tumors. The young gonad has also been considered as primarily testicular and later ovarian tissue with ova grows around and into it. The testicular tissue then atrophies and the gonad becomes an ovary. This is another source of Leydig and Sertoli cells.

The adrenal gland and the kidneys develop in close proximity to the ovary and hypernephroma of the ovary has been described. Schiller has recently demonstrated a new tumor of the ovary, the so called "mesonephroma", its tissues look very like renal parenchyme. Thus the sources of the special tumors that are seen in the ovary are quite obvious—the granulosa cell tumor, the thecal cell tumor, the lutein tumor, the arrhenoblastoma, the testicular tubular adenoma, tumors suggesting Leydig cells, and so forth.

#### TYPES OF TUMORS GROSS AND HISTOLOGICAL

The tumors were of all sorts large, small, papillary, smooth walled, cystic, solid, solid and cystic, white, yellow, hemorrhagic, etc. Except for the pseudomucinous tumor there is no way of predicting the microscopic type from its appearance. Histologically two definite types were made out, one, the pseudomucinous tumor which is obvious to all, with its high columnar cells full of pseudomucin, the other, which we call the endometrial type, resembles carcinoma of the endometrium. This tumor is not difficult to differentiate. There is yet another and larger group which we designate "unclassified," without characteristic cell type. Some are clear celled, slightly resembling lutein cells or the cells of the hypernephroma. Others tend toward

squamous epithelium. Still others are like carcinoma simplex. Any tumor that was not of a pseudomucinous type or an endometrial type was placed in the unclassified group. Ovarian tumors grow in different forms. There was the true solid tumor the solid tumor with necrotic areas in it and the solid tumor with definite epithelial lined cystic areas in it papillary and not papillary. There was also the definite papillary cystadenoma with small or large papillary projections inside or outside the tumor or both. It was decided to divide the tumors into two groups, solid and papillary cyst adenomas. (In the first two papers from this clinic they were divided into three groups solid tumors, or the solid tumors with cystic areas in them a group of malignant papillary cystadenomas that had adenocarcinoma or tumor resembling adenocarcinoma in its walls and malignant papillary cystadenomas.) In this paper the last two groups will be combined into one—the malignant papillary cystadenoma. In the gross a tumor might appear solid with cystic areas in it and papillary processes in the cyst. Microscopically such tumors may have solid cords of epithelium in them but if papillary adenocarcinoma predominates microscopically it will be called a malignant papillary cyst adenoma. The true solid carcinoma of the ovary is usually solid carcinoma plus stroma, and the cystic areas in it are those of degeneration and necrosis. The endometrial type of tumor is interesting. There is no reason why there should not be an endometrial tumor of the ovary for the epithelial covering of the ovary arises from the celomic epithelium. As the celomic epithelium is the source of the muellerian epithelium that produces the endometrium, endometrial cancer should and does occur. Thus it is not unusual to find tumors suggesting muellerian epithelium in the ovary.

The criteria of malignancy used were atypicity of cells, mitotic activity, invasion of the walls, undifferentiation and evidence of more progressive and invasive growth than is seen in the benign papillary cystadenoma. After microscopic study there was no doubt about the diagnosis of malignancy in any of these cases. The end results usually confirmed the microscopic findings. When a patient dies

of her tumor there is very little doubt of its malignant nature.

#### ENTIRELY SOLID AND SOLID PLUS CYSTIC CARCINOMA OF THE OVARY

This group is by far the most serious. About one fourth are inoperable and the symptoms are of short duration. Some of the tumors have cystic areas in them but they are usually due to necrosis. (If there were cystic epithelial areas in a solid tumor and if the tumor in such a cyst microscopically was papillary adenocarcinoma it was called a malignant papillary cystadenoma.) The solid tumors were of various sizes, from small to large. Very frequently the tumor was adherent in the pelvis or the cancer had grown to the peritoneal surfaces and become adherent to the walls of the pelvis. The gross pathology of these solid tumors may be very similar but the histology is rarely the same. They grow as medullary squamous, or adenocarcinoma. Its cell type may be pseudomucinous, endometrial, or unclassified the great majority being unclassified. The study of these tumors has made such an impression upon us that if in the future there is any question of an ovarian tumor in any patient, or if the ovary is hard or unusual, the patient will either be peritoneoscoped or operated upon. It is inexcusable to observe and wait because the prognosis is so very bad. In patients in the menopause age let us say the age of 45 it is the intention of the author to be radical in the treatment of ovaries in the future. They will be removed unless there is a specific request to leave them. These tumors may be accompanied by abnormal uterine bleeding either before or after the menopause. They can be responsible for an estrin phase in the endometrium because some of their epithelium secretes estrin. In this series 44.4 per cent of the tumors were bilateral and only 9.3 per cent are living. Therefore radical surgery should be the treatment. Both tubes, both ovaries, the uterus and cervix should be removed if possible. Even if there is no evidence of tumor in the other ovary it should be removed along with the uterus and cervix. No attempt should ever be made to conserve the opposite ovary in a patient who has a

solid epithelial tumor of the ovary In 22 2 per cent rupture of the tumor occurred before removal and 12 5 per cent lived, a better result than the 9 7 per cent survival of all solid tumors, nevertheless rupture should be avoided These tumors metastasize far and wide, to the umbilicus, the axilla, the bone, etc Each patient should be seen regularly for follow-up to determine whether or not she is free of her disease X-ray treatment is unquestionably of value in prolonging life, but up to the present time we have not satisfied ourselves that it has ever cured There can be no doubt of the value of peritoneoscopy in this group of patients, and it must be used more frequently in diagnosing these tumors

#### MALIGNANT PAPILLARY CYSTADENOMA

In the 2 previous papers an attempt was made to separate these cases into those with and without areas of adenocarcinoma in the walls There is no need for this division These tumors are cystic and papillary They may have large masses of papillary tissue or they may have only small areas There may be penetration of the wall of the cyst, or the papillary areas may be entirely within the cyst itself They are frequently adherent and may become widespread throughout the peritoneal cavity The omentum may occasionally be full of tumor They metastasize far and wide, as do the solid tumors Because they are papillary, which means slower growth, and because fewer of them become densely adherent or break through the wall of the cyst the results are better than in the solid tumor Often surgeons remove a cyst of the ovary and take out but one ovary and do nothing more to the patient, and then later find that the laboratory reports the tumor as carcinoma If this has been done and the tumor is a carcinoma it is best to re-operate upon the patient and remove the other ovary, the uterus, and the cervix Because these tumors are so frequently bilateral, 32 9 per cent, it is easy to conceive that the other ovary may develop a malignant tumor It ought to be removed It is essential that an ovarian tumor should be opened and looked at by the surgeon, and a pathologist should view it if possible before the abdomen is

closed If it is malignant further surgery should be undertaken It is often customary for surgeons operating upon patients with large cysts of the ovary to remove the fluid with a trocar before excising them The results in this series show that those cysts that have been ruptured or have had a trocar used upon them, 25 6 per cent, do better than those that haven't—28 5 per cent as against 21 9 per cent Nevertheless it is the feeling of the author that small areas of tumor tissue can be spilled and therefore it is not advisable It must be safer to remove the cyst whole, without spilling, than to spill fluid with pieces of carcinoma into the abdomen Certainly great care is exercised not to spill the cells of other tumors and there is no reason why this group should be chosen as one in which it does no harm to use a trocar If a big incision is necessary it should be made, but tapping should not be done Hodenpyl's theory, advocated years ago, for the treatment of carcinoma with ascitic fluid from patients suffering with malignant disease may be the explanation of the survival of more patients who had spontaneously ruptured tumors or trocared tumors, but nevertheless it does not seem safe to the author to do it deliberately If, however, one does spill the fluid of a cyst or does operate upon one that is ruptured it does not mean that that particular patient will not have a good prognosis

Between these two groups there is a great difference in the prognosis, the prognosis of the solid tumor being extremely bad, and that of the malignant papillary cystadenoma being about the same as other types of malignant disease

#### SYMPTOMS AND DIAGNOSIS

The symptoms of patients with solid carcinoma of the ovary and of malignant papillary cystadenoma are about the same Ovarian cancer often gives no symptoms until it is well advanced Frequently increasing size of the abdomen due to the tumor is considered increasing weight and heaviness due to the age of the patient There is often a sense of vaginal discomfort and pressure Occasionally there are slight gastro-intestinal symptoms Later on the symptoms are those of



loss of weight and urinary difficulty. Ascites is not uncommon. Pain is the commonest symptom. 68 per cent of the solid carcinomas and 65 per cent of the cystic tumors complained of this symptom. About 50 per cent of both groups complained of abdominal swelling. Loss of weight was noticed in about two-fifths of the cystic tumors and one-third of the solid tumors. Urinary symptoms were not uncommon being present in 41 per cent of the cystic tumors and 25 per cent of the solid ones. Ascites does not necessarily mean a hopeless prognosis, for even simple cysts and fibroids can be accompanied by ascites. Fluid in the abdomen and fluid in the chest in the presence of an ovarian tumor may not mean hopeless malignancy. In a paper published by the author in the *Annals of Surgery* (6) 15 cases of fibroma of the ovary (a simple benign tumor) have been shown to be accompanied by fluid in the abdomen and fluid in the chest. Therefore it behooves us to be ready to operate upon patients who have tumors of the ovary with fluid in the abdomen and chest and to settle whether or not the tumor may be a simple fibroma rather than a malignant lesion. It has been reported that benign cysts and fibroids may be accompanied by fluid in the chest as well as in the abdomen. About one half of the patients are in the decades 30 to 40 and 40 to 50. There are more young patients in the malignant papillary cystadenoma group than in the solid carcinoma group. The fertility in married women in both the solid and cystic tumors is approximately the same—60 and 63 per cent. This is a low incidence of fertility as 90 per cent is usually given as the normal incidence of fertility (7). Because of the lack of fertility in this group of patients it is necessary to consider the possibility of there being some congenital defect of the ovary. If some congenital developmental abnormality were present there should be an increased chance for growth of left-over cells and hence the production of abnormal growth. About 27 to 30 per cent of the group menstruated regularly and normally. Over 50 per cent had the menopause, while about 25 to 30 per cent gave a history of abnormal bleeding. Their abnormal bleeding is probably due to the fact that

many of these tumors secrete estrin and therefore activate the endometrium. Not all active endometrium following the menopause indicates the presence of a granulosa cell tumor. It is the feeling of the author that some of the patients that have small papillary implantations in the omentum and the peritoneum who are cured by removal of the ovarian tumor may be of this type that is, the tumor may be endometrial, and as estrin which may be present in the ovarian tumor causes a growth of the endometrium it perhaps causes a growth of the implanted node. As estrin is a growth producer it may be responsible for the activity of these bits of tumor. This is another reason for removing both ovaries and stopping wherever possible all estrin production. It is correct to assume that some estrin may be produced by the tumor because the tumor has its origin from cells which make up the ovary and certainly some of these can produce estrin.

#### MISCELLANEOUS STUDIES

There were a number of inoperable tumors in this series. In these patients an exploration was carried out, a specimen removed, the ovary observed and a diagnosis made as to whether or not the tumor arose in the ovary. In about one-quarter of the solid tumors and in one tenth of the cystic group this was all that could be done. It is interesting to note that in the group treated with x-ray after operation, there were about the same number of inoperable cases as in the group who did not have x-ray therapy. There were more patients in the solid group with a short history from onset to operation, and more died in the first year after operation, showing that this type of tumor is really different from the cystic type. In this series the survival rate of patients with bilateral tumors of the solid type was only very slightly below that for the entire group and was better in the cystic groups. There is doubt that those with bilateral tumors have a worse prognosis than those with unilateral tumors. Because of the frequency of bilateral tumors, it is difficult to believe that the surgeons in our hospital removed only one ovary in as many as 20.8 per cent of the patients with solid malignant

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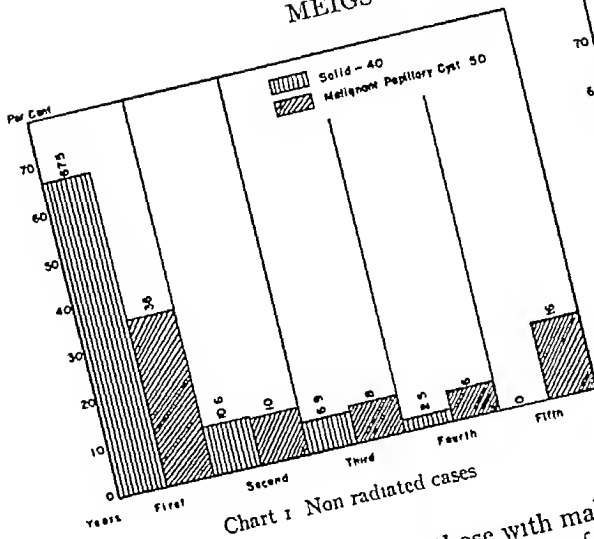


Chart 1 Non radiated cases

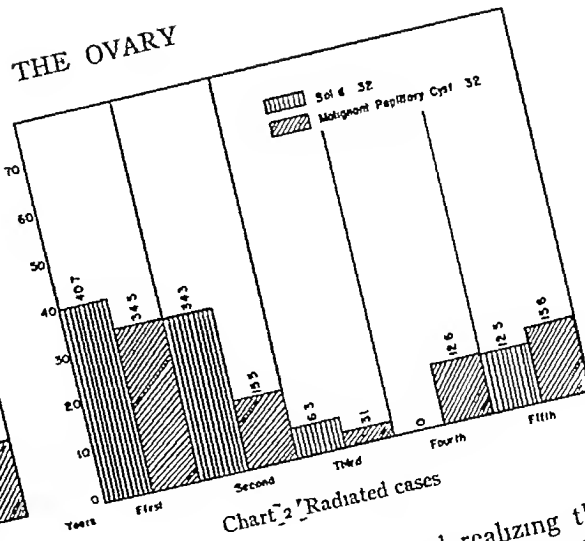


Chart 2 Radiated cases

mors, and 22.2 per cent in those with malignant papillary cystadenomas. In spite of the knowledge that so many of these tumors are bilateral, we did not take advantage of our knowledge. In the solid tumors unilateral oophorectomy cured but 6.6 per cent, and in the malignant papillary cyst adenomas, only 16.8 per cent. These curability rates are below the survival rate for either group as a whole. The results of bilateral oophorectomy are better in both groups, the solid group showing a survival rate of 11.4 per cent, and the cystic group, 28.1 per cent. It is also of interest to note that only 6 per cent of the patients in the cystic group had a tumor appear later in the other ovary, while this occurred in none of the solid group. As all cases have been followed carefully for some time this fact is certainly interesting. It may be that we were fortunate, certainly we have not been wise, but from now on I feel sure there will be fewer and fewer times in our hospital that unilateral oophorectomy will be done for carcinoma. Because uterine involvement is so serious the removal of the ovary, uterus, and cervix is best if possible. The presence of adhesions was of serious consequence in the solid group, the results being poorer than those for the whole group. Uterine involvement was very serious as no patient survived 5 years. Postoperative mortality was surprisingly low. Realizing that a large group of these patients were inoperable, 25.6 per cent of the solid group and 10.9 per

cent of the cystic group, and realizing that many were operated upon and a desperate attempt was made to remove the pelvic organs it is surprising to find a mortality of only 12.5 per cent in the solid and 3.6 per cent in the cystic group. Figures showing the rate of death following operation are of interest. 55.5 per cent of the solid group died within 1 year and 35.2 per cent of the malignant papillary cystadenomas. These figures point to the very serious consideration that must be given to solid tumors of the ovary of the epithelial type.

## TREATMENT

The required treatment of all groups is operative. An accurate diagnosis cannot be made without surgery. Operation should be advised early and insisted upon. Peritoneoscopy should prove of great value in making the diagnosis. It should be the duty of every clinic to have some one familiar with peritoneoscopy, as this should be our greatest help in diagnosing this condition. Any doubtful pelvic examination should be checked by peritoneoscopy or else operation itself should be carried out. The operation should be radical. Whenever possible both tubes, both ovaries, the uterus and the cervix should be removed. It is a good rule, in all ovarian cancers to remove as much tumor as possible and all the pelvic genital organs if the patient's condition will permit. A total hysterectomy is done because the tumors

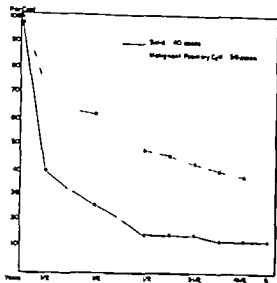


Chart 3 Non-radiated cases.

sometimes metastasize to the uterus, and if they do the chain of lymphatics from the uterus to the cervix may allow further extension of growth. Certain schools advise leaving the uterus behind so it can be used as a focus for radium therapy. Inasmuch as surgery is the best means of treatment and because the new x ray apparatus can deliver a lethal dosage into the pelvis it is safer to remove the uterus than to leave it for subsequent radium treatment. It cannot be too frequently brought to the attention of surgeons that it is essential to open any tumor that is removed before the abdomen is closed. If papillary processes are found on the outside of a cyst it is best to adopt radical surgery and remove all the pelvic organs, no matter what the age of the patient. If papillary projections are found within a freely movable tumor and the patient is young and wants children conservation is justifiable. In such cases it is important that the patient be seen at least every 6 months for 5 years or more because if a neoplasm can develop in one ovary the same embryonic background is probably present in the other and a tumor may develop in it. In the proper management in malignant lesions of the ovary radical surgery is the rule and conservation of ovarian tissue the exception.

## RESULTS OF TREATMENT

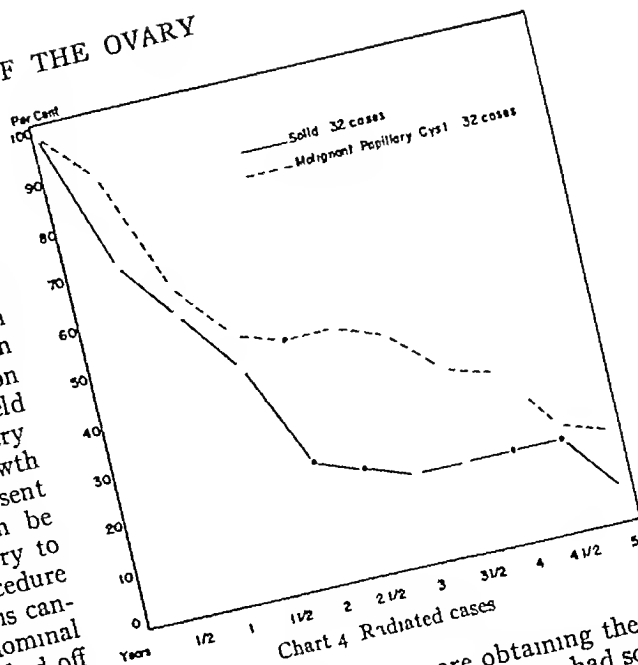
Results of surgical treatment, including the patients who have had x ray treatment, showed that in the solid group only 9.7 per cent of 72 patients survived for 5 years. In this study all patients living with disease at 5 years, or dying with disease after 5 years, have been considered as dead at 5 years. In the graphs this accounts for the sudden drop from 43% to 5 years. Up to then it is interesting to note the very flat curve of the solid cancers of the ovary and the slowly dropping curve of the malignant papillary cysts. It is possible that the solid tumors are more surely cured if the tumor is removed than the papillary tumors which may more likely have small papillary areas of slowly growing tumor left behind after operation. End-results, according to histological classification showed that the most favorable type in the solid group are the endometrial type while the pseudomucinous type was the worst. In the cystic group 21.9 per cent in 82 patients survived. Those classified as the pseudomucinous type did best in the cystic group with 25.0 per cent surviving 5 years. The endometrial type did poorly. It is well to consider the endometrial type. This tumor like cancer of the endometrium does not become very malignant until it has grown outside the ovary or the uterus. Once free in the peritoneal cavity it is one of the most malignant of all pelvic tumors. In a series of cases of cancer of the endometrium reported from the Poodville Hospital (3) it was found that this tumor metastasized farther and more frequently than cancer of the cervix. Once it was outside the body of the uterus nothing could check its growth. It is understandable therefore why this tumor seems to be responsible for the most consistently bad end-results.

## ROENTGEN RAY TREATMENT

There can be no doubt that treatment by means of radiation following surgery is valuable but it is the opinion of the author as a result of the study of these three reports that although roentgen treatment may slow or retard growth it does not cure. Perhaps after further experience with the million and the 500,000 volt machines a new type of treatment

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will come about. At the present time life is prolonged but subsequent death is not prevented. X-ray treatment should be used in cases that have peritoneal extension, adhesions, whenever cyst fluid has been spilled, when a complete operation cannot be done, and in all cases in which there is any question as to the perfection of the surgery. If a clean and complete excision has been done radiation should not be used but should be withheld so that it can be used later if necessary. Roentgen treatment will slow up the growth of cancer deep in the pelvis. The present method of treating ovarian cancer can be improved upon. Although it is necessary to treat the entire abdomen the usual procedure is to treat only two or three fields. This cannot adequately cover the entire abdominal cavity, so that unless each field is marked off and treated certain areas are sure to be missed. It is very important to insist on accurate and thorough radiation if it is to be given. It is the surgeon's duty to make a note of the location of the metastatic areas, where the adhesions were, and where the tumor has extended. These areas should be marked on an abdominal chart and sent to the x-ray department when the patient is to be treated. The surgeon should discuss the lesion with the roentgenologist and decide where and how the tumor shall be treated. The roentgenologist should be called to the amphitheater at the time of operation. He cannot know the exact location of the tumor in the pelvis unless he sees it or is told. It is necessary that the surgeon himself show him where the tumor is or was. Although our group is not a large one it is well followed and studied and the treatment was the best that could be given at the Massachusetts General Hospital at that time. Most of the patients were treated with 200,000 volt machine, with the usual screening amperage, and so on. The treatment has varied from time to time, as it has in other clinics. It is fair to assume that these patients were adequately treated so far as treatment was possible. Undoubtedly better results are being obtained but we have to report only a 0.7 per cent gain since the first paper was written. Eventually we will have better results but at the present time it is not the



author's opinion that we are obtaining them. Fifty per cent of the radiation group had solid cancer with 6.2 per cent living 5 years without disease. This must be contrasted with 12.5 per cent living in a similar group not radiated. In the malignant papillary cystadenoma group also the patients not radiated did better than those who were radiated, 24 per cent as against 18.7 per cent. The groups were fairly comparable, there being inoperable cases in both groups and cases in which death from cancer occurred from 5 to 15 years later. It is apparent from this study as far as it goes that no more people were cured with radiation than without it. Up to the present time the greatest reliance must be placed upon surgery. It is more hopeful, however, to view the length of life in months of the patients having radiation, as compared to those not having it. Here it is clear that in the most malignant type, the solid tumors, radiation prolonged life, 20.9 months as compared to 7.5 months, but in the cystic group life was longer without it, 21.5 months compared with 22.9 months. Both series show that the treatment given was not of too great value. It is my belief, however, that much better results will be forthcoming and that further analysis of this peculiar group with due consideration given to the extent of disease and the amount

and type of radiation may show that radiation of ovarian cancer is of greater value than it now appears to be. Without choosing cases this type of therapy has not proved so valuable as we thought it would. When we learn what types of malignant disease of the ovary respond to radiation that is the cell type when we learn to confer and consult with our roentgenologists as to the proper places for treatment and when the roentgenologist places the patient on the table himself and points the x-ray tube at the lesion, then I believe that our results will be better. Until full co-operation is obtained between the pathologist, who knows the histology of tumors, the surgeon who knows the location of the lesion and the roentgenologist who knows how to get full value from his machine and how to place the patient and the tube, better results will not be obtained.

#### ANALYSIS OF STUDY

Cancer of the ovary is a very serious lesion and the solid type rates with the very worst of all malignant disease. The record at the Massachusetts General Hospital is not a brilliant one but it is likely that it represents at least the results of the community at large. The figures show as the percentage of curability is only 15.5 per cent, that more propaganda for early treatment should be started. This tumor ranks with carcinoma of the stomach as one of the most serious of all cancers, for cancer of the breast, cervix, and rectum give better results. Ovarian cancer found early should be curable in many cases. It is our problem to try to find a way by which the diagnosis can be made early. Perhaps more careful histories, more heed to abnormal menstrual symptoms, hormone studies, and painstaking pelvic or rectal examinations of all women is a way to attack the problem. Exploration of the pelvis with the peritoneoscope is another method of attack. Our results will not be better until we are able to diagnose cases earlier. If these figures from the Massachusetts General Hospital are typical of those throughout the country then we must all change and insist upon radical surgery in every case. Having one ovary left in may cheer the patient, but it may be a very

serious thing for her in the final analysis. Tapping of cysts first may make the incision smaller and the operation easier but it seems reasonable that the removal of a papillary or partially solid tumor *in toto* should prove more valuable in the end. Cancer of the ovary if found early is curable for it is often encapsulated in the ovary and is not serious until the cyst is broken or perforated and the tumor has grown through the wall. It is far better to remove a simple cyst or a fibroid because of mistaken diagnosis than to wait to see whether a given lesion becomes malignant. The use of the peritoneoscope must be encouraged and a peritoneoscopist should be present in every hospital. X-ray should be reserved for those patients in whom it has been impossible to do perfect work. To feel any reliance upon it as a method of clearing up a poorly done operation is very undesirable. I believe that the co-operation of the surgeon, the pathologist, and the radiologist in outlining the treatment for a patient with cancer of the ovary will probably prove to be the most valuable part of any advance in roentgen treatment.

#### SUMMARY AND CONCLUSIONS

Cancer of the ovary of the solid type is a very serious neoplasm.

Cancer of the ovary of the malignant papillary cystadenoma type is about as malignant as any other epithelial growth.

Early diagnosis and methods for early diagnosis are necessary to improve the end-results.

The use of the peritoneoscope should prove of extreme value.

Bilateral oophorectomy with total hysterectomy is the proper treatment.

Involvement of the uterus, adhesions, and growth through the wall of a tumor are extremely dangerous.

The rupture of cysts before and during operation is condemned but the results of this series cannot support the condemnation. It is the author's belief that spilling of cyst contents should be avoided.

X-ray treatment to date has not proved of much curative value but more modern methods may

# MFIGS CANCER OF THE OVARY

It is obvious from our study that it is necessary to have the co operation of the surgeon, the pathologist and the roentgenologist in the treatment of tumors of the ovary before more favorable results can be obtained.

Every cystic or solid tumor of the ovary that is removed singly should be opened by the surgeon before the wound in the abdomen is closed.

If cancer is found in a single ovary by the pathological department resort should not be made to radiation but the patient should be re operated upon and radical surgery carried out.

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ries in which the appendix was ruptured, 8 being due to general peritonitis and 1 to pneumonia. Five of the 9 deaths occurred in that group in which appendectomy had been performed whereas 2 occurred in each of the 2 other groups, namely those having simple drainage and those receiving conservative non-operative treatment. In the series of 31 cases without rupture there were 4 deaths which 2 were due to pneumonia, 1 to cardiac failure, and 1 to pulmonary embolism.

The type of anesthesia employed for the operation seemed to have no apparent influence on the mortality rate, as approximately the same number of patients received spinal anesthesia as received general gas-ether anesthesia and approximately the same number of deaths occurred in each group.

The pathological picture in relation to the time element is interesting in these two groups. In the 31 cases in which the appendix was ruptured there were 17 cases with gangrenous appendix while the 14 remaining showed varying degrees of acute purulent appendicitis. Of this entire group there were 20 cases in which the disease was of less than 24 hours' duration, 8 cases of less than 48 hours', and only 3 of more than 48 hours' duration. The history was considered atypical in 20 of the 31 cases of this group.

In the series of 51 cases in which the appendix was ruptured there were only 17 cases in which the disease was of 48 hours' duration or less. In several instances it had been present several days to even a few weeks before the first examination at the clinic. There were 29 patients with general peritonitis, 11 with abscess formation, 7 with gangrenous appendix and some degree of localizing peritonitis, and 4 in whose cases the pathological condition was not described. The history in at least 30 of these 51 cases in this group can be considered as atypical.

#### SYMPTOMS AND DIAGNOSIS

One is impressed by the fact that the clinical syndrome of acute appendicitis in this older age group differs somewhat from that manifested in youth. Any categorical statements concerning the symptoms of appendicitis in the aged, and their sequence of occurrence,

become more obviously unreliable as these cases are studied in detail. When at least 50 of the histories in these cases were considered as atypical, the standard of reference was the usual textbook story of appendicitis with epigastric distress, then pain in the lower right quadrant, nausea, vomiting, and so forth. This textbook picture of appendicitis may and does occur in people of the older age group, but it occurs sufficiently infrequently that it might be called the atypical picture of acute appendicitis in patients more than 60 years of age.

In these patients, as has been mentioned, a characteristic attack of appendicitis may develop, but there seems more likely to be lower abdominal pain with localization over McBurney's point, leucocytosis, but frequently no fever, nausea, or vomiting. These findings may be all that is present for 2 or 3 days, or even a week, before more toxic symptoms develop. The more severe symptoms which then appear are usually those of either localized or diffuse peritonitis.

In the majority of instances the patient has a rather mild cramp-like, intermittent type of general lower abdominal pain. This is associated with a mild indescribable dyspepsia and constipation. The pain is usually considered as being due to constipation and a cathartic or an enema is taken. This pain tends to localize in the right lower quadrant of the abdomen and tenderness develops over McBurney's point. If a leucocyte count is taken it is found to be elevated to between 9,000 and 15,000 in each cubic millimeter of blood. Occasionally the pain begins as a dull ache at McBurney's point and remains localized. Anorexia and, in a few instances, some degree of nausea are present. There is usually no vomiting, but occasionally the patient vomits once or twice in the early phases. However, this has subsided completely by the time the patient is seen. There is very little if any constitutional disturbance and the amount of pyrexia, if any is present, is small. Ordinarily the temperature is normal to slightly more than 99 degrees F. The pulse rate may be slightly elevated, but not significantly so. Frequently, as the symptoms progress, the cramp-like pains become more severe and abdominal distention



## APPENDICITIS AMONG INDIVIDUALS MORE THAN SIXTY YEARS OF AGE

LEONARD K. STALKER, M.D. Rochester Minnesota

THE greatest mortality for acute appendicitis occurs in patients more than 60 years of age. This can be attributed to the fact that the diagnosis is frequently overlooked or delayed because of the patient's age and because of the mildness and variability of the symptoms. For this reason it seemed advisable to us to review our cases of acute appendicitis which had occurred in individuals who were more than 60 years of age.

Approximately 1 to 2 per cent of all patients with acute appendicitis are more than 60 years of age. Taylor stated that, of 1000 patients with acute appendicitis admitted each year to the London Hospital 1.5 per cent were more than 60 years of age. Maylard found that 1.5 per cent of 1000 consecutive cases at Victoria Infirmary occurred in patients between 60 and 70 years of age and only 0.3 per cent in those more than 70 years of age.

The mortality of acute appendicitis in this group is variously reported at about 25 per cent. Taylor in a series of 110 cases, reported a mortality of 20 per cent. Wood in a series of 43 cases at the Peter Bent Brigham Hospital, had a 28 per cent mortality. Fitch, in a series of patients between 60 and 70 years of age had a 54 per cent mortality. The most common cause of death in these various series has been general peritonitis. Pneumonia has been next most frequent, whereas pulmonary embolism, cerebrovascular accidents, cardiac failure, septicemia, intestinal obstruction, and others have each accounted for a small percentage.

The pathological picture has been described by Taylor. He has stated that the almost constant course of acute appendicitis in old people is therefore—the first day engorgement, second day gangrene and local peritonitis, third day perforation with general peritonitis or abscess formation, fourth day and

after abscess. This is the pathological picture as described by others and as seen at the Mayo Clinic. Most authors have pointed out the atypical picture and mildness of symptoms which are presented by the majority of these patients.

In the majority of the 110 patients seen by Taylor in whom appendectomy was performed, the appendix was gangrenous and peritonitis was frequently present. Abscess formation had taken place in a large group and only drainage was instituted. Wood's series showed 55 per cent of the cases with appendicular abscesses, 9 per cent with general peritonitis, and 16 per cent with a gangrenous appendix at operation.

In the present paper a series of 82 cases of acute appendicitis which were seen from 1924 through 1938 at the Mayo Clinic is reviewed. A few cases in which operation was performed during the early part of the year 1939 are included to illustrate better the diagnostic problems which are presented.

There were 33 women and 49 men. Seventy patients were between 60 and 70 years of age and 12 were between 70 and 80 years of age. The youngest patient was 60 and the oldest 78 years, with an average of 65.1 years. I have operated upon a number of these patients and my observations together with the results of treatment in these cases collected from the records, are briefly summarized.

The appendix was ruptured in 51 of the 82 cases whereas in 31 it was unruptured. Appendectomy was performed in each of the 31 cases without rupture. In the 51 cases with a ruptured appendix, appendectomy was performed in 26 and simple drainage in 20 with a subsequent appendectomy in 8 of these 20 cases. Conservative non-operative treatment was instituted in 5 of the 51 cases with a ruptured appendix.

There were 13.159 per cent deaths in the entire series. Nine deaths occurred in the se-

ries in which the appendix was ruptured, 8 being due to general peritonitis and 1 to pneumonia. Five of the 9 deaths occurred in that group in which appendectomy had been performed whereas 2 occurred in each of the 2 other groups, namely those having simple drainage and those receiving conservative non-operative treatment. In the series of 31 cases without rupture there were 4 deaths of which 2 were due to pneumonia, 1 to cardiac failure, and 1 to pulmonary embolism.

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becomes apparent. This distention, together with the pain and the patient's age is often interpreted as intestinal obstruction due to a malignant condition of the colon.

Thus early in appendicitis in this age group there develops a lower abdominal cramp-like pain with localization at McBurney's point tenderness in this region, and leucocytosis. In spite of the fact that within the next 48 hours the appendix usually becomes gangrenous and subsequently ruptures the symptoms are still not acute enough for the patients to seek medical aid. Thus the majority of our patients had peritonitis and it was because of the symptoms of this peritonitis that they sought aid. As the appendix becomes gangrenous and peritonitis develops the picture resembling intestinal obstruction becomes even more apparent and frequently when patients are admitted at this phase much valuable time has been lost in an attempt to locate a suspected neoplasm. As peritonitis develops, more symptoms of toxicity manifest themselves and the patient may have considerable vomiting and fever. However other patients remain ambulatory throughout the entire course of their illness and come because a mass has developed in the right lower quadrant of the abdomen. This mass is usually proved to be an abscess.

#### REPORT OF CASES

Brief reports of a few illustrative cases are of interest.

**CASE 1.** A man, aged 60 years, came to the clinic complaining of para-umbilical cramp like pain of 6 hours duration which localized in the lower right quadrant of the abdomen. He had not had nausea, vomiting or other symptoms. There was tenderness of grade 3 on the basis of 1 to 4 over McBurney's point. The temperature was 99.5 degrees F and the pulse 80. The leucocytes numbered 4,000. An acutely inflamed appendix with feces formation in its tip and thin marked peri-appendicitis, as removed.

**CASE 2.** A woman, aged 60 years, as being examined at the clinic, began steady aching pain developed in the lower right quadrant. This was associated with tenderness over McBurney's point and leucocyte count of 700. There was no fever. The pain was of 6 hours duration when the appendix was removed and acute purulent peritonitis with marked peri-appendicitis was found.

**CASE 3.** A rather marked constipation developed in a man, 65 years of age, while he was recovering

from amputation of a leg. A dull aching pain subsequently developed in his lower right quadrant with tenderness over McBurney's point. There was no nausea and no vomiting. The temperature was 99 degrees F and the pulse rate 80 beats per minute. Leucocytes numbered 9,000. A gangrenous necrotic appendix with localizing peritonitis was found at operation.

**CASE 4.** A man, aged 70 years, as seen at the clinic, with cramp like lower abdominal pain of 4 hours duration. He had had a cerebrovascular accident and had Parkinson's disease and bilateral scrotal hernias. This pain localized at McBurney's point and was associated with tenderness. The patient vomited once at the onset but this had subsided. His abdomen was distended and visceral activity was slowed up. The temperature was 99 degrees F with pulse rate of 80. The leucocytes numbered 6,500 with 90 per cent neutrophils. At operation a ruptured gangrenous appendix with localized peritonitis was found.

**CASE 5.** A man, aged 66 years, was referred here with the diagnosis of intestinal obstruction. Forty-eight hours before admission rather sharp cramp-like umbilical pain which was referred to his lower right quadrant had developed. This was associated with vomiting and marked abdominal distention. On admission there was much tenderness over McBurney's point. The abdomen was distended grade 3 on the basis of 1 to 4 but as rather soft and doughy to the touch. A roentgenogram showed gas in the small intestine and colon, and while not diagnostic, as before suggestive of intestinal obstruction. The temperature was normal, but the pulse rate was 90 beats per minute. The leucocytes numbered 3,400 and the blood urea 50 milligrams. At operation general peritonitis as present and an acutely gangrenous appendix with rupture easily prevented itself as removed. The patient recovered.

**CASE 6.** A woman, aged 63 years came to the clinic 1 month after the onset of symptoms. She had had steady aching pain in the lower right quadrant of the abdomen. A few days after it met there as slight fever which gradually increased to 99.5 degrees F and at the end of 2 weeks mass in the lower right quadrant of the abdomen apparent. On admission here this mass as present. The temperature was 99.5 degrees F. Leucocytes numbered 9,500 with 75 per cent neutrophils. At no time had there been nausea or vomiting and the patient had never felt very ill. She was suspected first of having carcinoma of the cecum, but exploration revealed an old appendiceal abscess with ruptured purulent appendix.

**CASE 7.** A man, aged 60 years, as being examined the clinic because of diabetes and prostatic hypertrophy. Following massage of the prostate lower abdominal cramp like pain developed which localized in the lower right quadrant of the abdomen. There was associated tenderness over McBurney's point and leucocyte count of 10,000. There was

fever, nausea, or vomiting. The patient took salts and did not report to the clinic for 48 hours at which time the aforementioned findings were present. Drainage was instituted for acute appendicitis with rupture and general peritonitis.

CASE 8 A man, aged 73 years, went to his physician elsewhere because of epigastric distress with nausea. He was given alkalis with no benefit. The following day the pain localized in the lower right quadrant and he vomited, but because of his age he was still treated conservatively. On the third day the patient was referred here. There was much tenderness over McBurney's point and considerable gaseous distention of the abdomen. The temperature was 101 degrees F and the pulse 100. The leucocytes numbered 16,200 with 90 per cent neutrophils. An appendectomy was performed for acute gangrenous appendicitis with perforation and localizing peritonitis.

CASE 9 A man, aged 70 years, came to the clinic because of a generalized lower abdominal soreness which was most severe over McBurney's point. This had been present for 3 days. He had vomited once at the onset, but had been up and around and had taken cathartics. There was no fever. On admission he had a tender mass in the lower right quadrant of the abdomen. The pulse was 100. The leucocytes numbered 17,800. He had an acute ruptured appendix with an appendiceal abscess which was drained.

## TREATMENT

The diagnostic problem of the elderly patient with acute appendicitis as illustrated by these case reports is very different from that of the young one, but on the other hand it is felt that the surgical treatment should not be considered significantly different. In the uncomplicated cases the mortality is low and the patient more than 60 years of age stands the operation well. However, in the complicated cases, that is, in those cases in which there is a ruptured appendix with peritonitis, the mortality can be reduced by conservatism in the surgical procedure. In the main it is felt that there is no doubt that appendectomy should be the treatment of early acute appendicitis prior to perforation. In the face of a recently perforated appendix without definite localization of the peritonitis, immediate operation with drainage of the peritoneal cavity should be done.

If the patient's condition warrants it and if it can be done without greatly prolonging the operation, spreading the infection, traumatizing the infected tissues, and without undue breaking down of protective adhesions, appen-

dectomy should be performed. It must be said in this regard that elderly people seem to be able to make one effort to limit the peritonitis by adhesions, but if these are broken down the pus will spread, even though the source of infection is removed. For this reason, one must be more conservative in this group than in patients of a younger age group, in regard to the removal of the appendix when perforation and peritonitis are present. The greatest mortality of the entire series occurred in that group in which appendectomy was done in the presence of peritonitis.

Occasionally when definite perforation and peritonitis have been present for several hours to days and the patient's condition is poor, the conservative Ochsner type of treatment should be instituted. If peritonitis appears to be localizing, conservative treatment should be carried out for a few days until the abscess can be drained. Occasionally this type of abscess absorbs itself so that no immediate surgical treatment is needed. When an abscess is drained, no attempt should be made to remove the appendix unless it is free in the cavity of the abscess.

The question of subsequent appendectomy in these cases in which drainage alone has been done presents more of a problem than in the younger patient. However, it is felt that if the patient's condition warrants it he should be advised to return in 6 to 12 weeks for subsequent appendectomy. Owing to the fact that the appendix in these patients is prone to become gangrenous, one will occasionally find at this subsequent operation that the entire appendix has sloughed away.

With regard to the anesthetic in this series of cases, it has been almost exclusively either a gas-ether mixture or a spinal procaine preparation. The incidence of pulmonary complications and the incidence of death from any cause were about the same for each method. However, in these cases, appendectomy, if possible, was the object of the operation and complete relaxation of the abdominal wall was demanded of the anesthetist. But if operation is undertaken with specific purpose of drainage only and even if appendectomy is to be performed through a McBurney type of incision and the patient is slender, a combination

of regional anesthesia with procaine solution and intravenous pentothal sodium is often satisfactory. In addition to a careful individual selection of the anesthetic agent for each case an active postoperative regimen which is directed toward the prevention of pulmonary complications is instituted.

#### ANALYSIS OF STUDY

The diagnosis of acute appendicitis in individuals more than 60 years of age even when a characteristic history is obtainable, is frequently overlooked because of the rarity of the disease. One should become increasingly on the alert for the possibility of acute appendicitis in the diagnosis of any intra-abdominal symptoms in these patients. The symptoms of this entity may follow the established clinical clear-cut sequence but again the symptoms may be entirely atypical and so closely simulate the picture of intestinal obstruction and carcinoma that operative interference may be delayed. Any patient in this age group in whom lower abdominal cramp-like pains develop with localization and tenderness over McBurney's point and with a leucocytosis must be suspected of having acute appendicitis.

Several hypotheses have been proposed as to why this group should present such modified symptoms of their disease. There is every reason to suppose that the peritoneum and the appendix of a patient in the late decades should react differently to inflammation than they would have reacted in youth, for it has been demonstrated that the appendix shows an increasing amount of lymphoid tissue up to the age of 30, but that from this period on there occur atrophic and fibrous changes. Then too the sensitivity of these people to pain is less than in youth and psychologically there is an inclination of age to conceal illness. The presence of constipation in a large percentage of these patients seems significant. One cannot overlook the importance of vascular changes with certain degrees of impairment and slowing of the circulation. In many of these cases the causation of the appendicitis could be satisfactorily explained on the basis of a combination of these factors with a certain degree of appendiceal obstruction. The obstruction is

usually caused by the presence of an impacted fecalith, but occasionally it is caused by some anatomical deformity of the appendix as a result of its position, by adhesive bands, by contraction of the mesentery and the like. Any one of these factors together with the presence of the aforementioned factors could easily predispose to the type of appendicitis under discussion.

Though fecaliths were found obstructing the lumen in several of these cases, it is likely that the other causative factors of obstruction are of more significance in this older group than in younger patients. This can be explained by the pathological changes as mentioned which are taking place as a result of age and of the repeated attacks of appendicitis which many of these patients have had with resulting shortening of the mesentery, the formation of intraluminal septums and the like. When one or more of these factors which might cause obstruction are present and there is an already retarded circulation, with a decreased tissue resistance due to the disappearance of the lymphoid elements, it seems reasonable that when appendiceal obstruction occurs the course of the disease should be rapid with early gangrene perforation and peritonitis. Inasmuch as appendiceal obstruction early produces only localizing symptoms, one would not expect more symptoms in this group. This phenomenon, however, does not occur in every case but it occurs in some cases and probably occurs in many more than have heretofore been recognized. A pathological study of a large series of appendices has been made recently and the high incidence of obstruction was noticeable.

In performing operation in this group one must modify to a certain extent, the treatment applied to the younger patient. Both the patient and the course of the disease are different. Not only is the patient a poor operative risk, demanding the minimum of manipulation and anesthesia but the appendix is almost always gangrenous or about to become so. Peritonitis is usually present to some degree. These patients do not tolerate peritonitis well and every effort should be made to avoid further dissemination of infection. This can be done by conservatism in the surgical



## THE EFFECT OF PREGNANCY ON THE EXCRETION OF INTRAVENOUS DIODRAST IN RABBITS

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ANIMAL experimentation has led to diametrically opposed conclusions regarding the effect of pregnancy on the urinary tract. Mengert, in an extensive study of pregnancy in the cow, dog, cat, rabbit, guinea pig, rat, hog, and monkey, concluded that the ureters of those animals did not dilate during pregnancy that there was significant increase in the proportionate area of the ureteral sheath in the monkey and cow and that pregnancy showed no effect upon the ureters of common animals. He found that the average diameter of the ureter in the rabbit was slightly larger in the pregnant than in the non-pregnant, but considered the difference too slight to be of significance. Payne and Hodes, in a much less extensive study after injection of prolan, estrin, progesterin and in the normally pregnant rabbit, concluded that there is no ureteral dilatation in rabbits. Humbley Siegel, Hachtel and Dummer found no significant changes in the ureters after estrogenic injections in castrated dogs, as compared to castrated controls.

On the other hand, Bollinger found that in dogs the excretion of sodium thiosulfate is depressed in from 1 to 3 weeks after conception until delivery. Rossi found in intravenous urography in decapitated rabbits that there is definite evidence of delay in the production of the best concentration of the dye (best plate in the series) and that there is filling farther down the ureters in the pregnant than in the non-pregnant rabbits. He attributes this to atonicity of the ureteral musculature, which delays the progression of the ureteral contents. His figures are as follows. The best plate in the non-pregnant rabbit is obtained within 3 to 5 minutes after injection of the media. In the same rabbit when 21 to 25 days pregnant, the best plate is at 18 to 25 minutes after the injection of the media. He notes that

these changes are manifest a few days after conception, reach a maximum by the twenty first to twenty fifth days of pregnancy and then decrease in the last few days before delivery. Pregnancy in the rabbit is 30 days.

Of necessity in animal experimentation there are certain factors which are capable of vitiating results to some degree. Two undoubted factors here as in human pregnancy are marked variation of individual animals in response to pregnancy and, as indicated by Hortolomee, the ureters have a tendency to fill more completely when the bladder is full. In rabbits, urination is not controllable by the investigator and catheterization of the rabbit introduces an undesirable factor into the experiment. Finally Van Wageningen and Jenkins have demonstrated in monkeys that ureteral dilatation occurs in the very latter part of pregnancy. They have further shown that if the fetus be removed but the placenta allowed to remain to term, ureteral dilatation not only persists but is apt to increase in degree.

There have been investigations on the effect of the urine of pregnant women and of extracts of the glands of internal secretion particularly folliculin, corpus luteum and the gonadotropic hormones, in isolated ureters from animals. Villaret and his coworkers found that the urine of women near term inhibited the motility of the dog ureter *in vitro* in 2 of 13 ureters studied. Boonpian showed that there were substances in the urine of pregnant women capable of modifying the activity of the animal ureter kept alive *in vitro*. He considers pregnancy to be a physiological condition accompanied by a hormonal crisis. This crisis which reaches an equilibrium, is probably responsible for pyelo-ureteral hypokinesis. This state affects energy rhythm tone and consequently peristalsis of the efferent channels of the kidney. Contreras reported changes in the cow and the dog which are similar to those

of man. He found, through tests of motility at the various months in pregnant women, that the urine of human pregnancy at the eighth and ninth month showed its major effect upon the isolated dog ureter. Burrows, after long administration of estrogenic substances in mice, found that there was a dilatation of the bladder and ureters, with hydronephrosis occurring with some frequency. In some of his mice, a purulent pyelitis and cystitis occurred. Grossu-Streja and Georgesco studied pig ureters. They conclude that folliculin, corpus luteum extract, and the gonadotropic hormone inhibit ureteral peristalsis to some extent. Schmitz finds the influence of hormones on isolated pig ureter not constant.

Pyelonephritis and ureteral dilatation have been recognized in veterinary medicine. Mirabeau mentions bilateral pyelonephritis in cattle. Jones and Little described 13 autopsy protocols which showed the renal lesion to be very like pyelonephritis in the human being. He believes that pregnancy plays an important part in increasing the severity of the disease. The untoward effects of these infections are most apt to appear in the latter part of pregnancy and in the puerperium. The pyelonephritis of pregnancy is almost universally fatal. Fraser, Godden and Thomson described a calcium deficiency in sheep which they compared symptomatically with "pregnancy disease" which seems to be a toxic condition, but which sometimes shows renal and fever manifestations. Loebel described pyelonephritis in a sow with autopsy findings. Vontobel, McIntosh, and Hall-Mashefer have contributed further in these reports of urinary disease in animals. Boyd and Bishop note that the condition has long been recognized in Europe but was not reported in the United States until 1918. The infection is now known to exist in most parts of this country. He finds it seldom recognizable until just before delivery, or in the puerperium. By means of rectal examinations, palpated ureters and bladder wall can be thickened ureters have been shown at autopsy which were filled with pus and debris and measured from 2 to 6 centimeters in diameter. Baker, in discussion of Boyd and Bishop, mentioned that a similar condition existed in ewes. The condition was universally fatal. He had

produced abortion by the use of pituitrin and saved some of the sheep. Hadleigh Marsh, a veterinary pathologist of the research laboratories of Bozeman, Montana, states in a personal communication that he has not noted or heard of pyelonephritis in range cattle, but it might exist unrecognized. He has seen it in beef cows twice and once in the college herd. Schoening, head of the pathological division of the Bureau of Animal Industry, Washington, D C, refers those interested to the text, *The Practice of Veterinary Medicine*, by D H Udall, 1936.

One source of confusion, which has led to opposite points of view on the influence of pregnancy on the urinary tract in animals is the attempt which some observers have made to make animal pyelography approximate human pyelography. This has led to denial that pregnancy influences the ureters of animals, because pelvic and ureteral dilatations which are comparable to those commonly seen in human beings are not produced in quadrupeds.

Of some interest are the observations by qualified physicians who have worked among the aborigines, who state that they have not seen urinary infection in pregnancy in practice among these people.

Analysis of the present point of view among investigators of the urinary changes in pregnancy in man indicates almost complete agreement among them that there is a double etiology for these changes. The primary factor is atony of the musculature, which leads to the slowing of the conveyance of the urine from the secreting unit, the cortex, weakening of the ureteral jet, and, in pyelography, delay in filling, which seems to be due chiefly to failure of the dye to be distributed. The second factor is pressure of the pregnant uterus against the exposed portion of the ureter, where it crosses the brim of the bony pelvis. In quadrupeds, this pressure factor is for the most part, if not completely, absent. It is not to be expected that the pregnant animal will demonstrate large pelvo-ureteral dilatations except in the presence of complications or when there is plugging of the channels with pus, blood, and debris. Therefore, the significant test of the influence of pregnancy on the urinary channels





Fig. 1. Compression band

in animals will be whether or not the musculature of the urinary tract evidences pregnancy atony.

It has seemed to us that Rossi's observations were of such significance that they were worthy of repetition. In addition we have attempted to add a mechanical appliance which would supply the pressure factor. The latter venture was not wholly successful. It was not possible to apply the apparatus satisfactorily in all cases. The rabbit's bladder was sometimes full of urine, sometimes nearly empty and the period of application was necessarily short as compared with the probable duration in animals which are more nearly erect, and in man in whom the pressure factor is the result of natural processes.

*Method of study employed.* In this study we have followed as nearly as possible the methods which had been used by Rossi. In addition an attempt was made to apply pressure at the pelvic brim, both in the pregnant and non-pregnant rabbits, that there might be a comparison between the effects of pressures in the two states. (The same rabbits were used throughout the experiments.)

A virgin rabbit was filmed for record. Ten cubic centimeters of diodrast was injected into the ear vein. The injection time was recorded. A film was exposed during the injection and at 1 minute intervals after the injection, until the concentration of the dye in the urinary tract began to diminish. After the lapse of sufficient time for the elimination of the dye from the circulation, usually 2 hours or more a film was taken to indicate that point. After a pressure apparatus (Fig. 1) had been applied for 5 minutes, the rabbit was reinjected with 10 cubic centimeters of diodrast. The pressure apparatus consisted of an elastic webbing with a buckle and two fitted blocks of wood which were of suitable size and shape to fit over the pelvic bones and

compress the abdominal contents and the ureters against the iliopsoas muscles. The injection time was recorded and the time at which the filling of the kidney was determined as before to produce the best concentration of the dye. Films were taken at 1 minute intervals, as they were in the experiment without pressure. The rabbit was then exposed to a male under supervision of a caretaker. When served, the date was recorded. Between the twentieth and twenty-fifth day of pregnancy the rabbit was reinjected with 10 cubic centimeters of diodrast and a plate was taken immediately and then at 5 minute intervals until the density of the dye began to fade. After the lapse of 2 hours, the rabbit was given pressure for 5 minutes and again injected with 10 cubic centimeters of diodrast. Films were taken immediately and at 5 minute intervals until the dye began to fade.

Eight rabbits were used in the experiments. Two rabbits died after the preliminary radiations. Two rabbits failed to become pregnant. The x ray exposure was 400 milliamperes at 1/40th of a second with the tube at a distance of 42 inches. The films obtained in these experiments were examined under proper lighting and the width of the ureter determined in millimeters, by caliper measurement, and the length of the filling toward the bladder recorded. A source of error in the latter measurement was the frequency with which a clearly visible ureter passed over onto the vertebrae and became lost to view. If error exists due to this cause, it is in the nature of incomplete record of the actual length of ureter which appeared and would probably indicate an even more pronounced effect of pregnancy since with one exception, this difficulty was encountered in the pregnancy cases. In the non-pregnant cases, especially without pressure, ureteral filling which extended much below the renal pelvis was seldom seen.

In stating the results of this study the right kidney is referred to as the high kidney and the left as the low kidney. This terminology is employed for ready reference to the pyelography.

Following is a summation of the time at which the best plate in each series was ob-



plate was taken at 3 minutes. Rabbit failed to become pregnant.

### SUMMARY OF EXPERIMENT RABBIT 2

	Low kidney				High kidney		
	Best plate time	Diastolic time	Filling time	Comments	Diastolic time	Filling time	Comments
Non-pregnant			12	Passed over vertebrae	1	Filled	Very faint
Non-pregnant pressure		1	26	Passed over vertebrae	1	Filled	

**Rabbit 3.** Black and grey white face and neck. Tag No. 89. Plain plate previous to injection. *Non-pregnant.* Ten cubic centimeters diodrast was injected into the ear vein. Injection time, 40 seconds. Plates were taken 1 20 seconds (5 cubic centimeters) and at end of injection, 3 3 4, and 5 minutes. The best plate was made 1 minute after completion of the injection.

*Non-pregnant with pressure.* Rabbit was re-injected after 4 hours, 47 minutes. Ten cubic centimeters diodrast was used. Injection time was 20 seconds. Plates were made 1 20 seconds, 3 4 and 5 minutes. The best plate was made at 4 minutes. Rabbit failed to become pregnant.

### SUMMARY OF RESULTS IN RABBIT 3

	Low kidney			High kidney	
	Best plate time	Diastolic time	Filling time	Diastolic time	Filling time
Non-pregnant		One in abdomen, not measurable			20
Non-pregnant pressure		20	Filled		4

**Rabbit 4.** Large rabbit. Tag. Plain plate previous to injection. *Non-pregnant.* Ten cubic centimeters of diodrast was injected. Injection time, 50 seconds. Plates were made 1 end of injection, and at 3 4, and 5 minutes. The best plate was obtained 1 3 minutes.

*Non-pregnant with pressure.* Injection was made after 3 hours, 3 minutes. Injection time was 20 seconds. Plates were taken at 20 seconds, 3 4 and 5 minutes. The best plate was made at 4 minutes. Rabbit died on fourth day after experiment.

**Rabbit 4a.** Replacement for Rabbit 4. Plain plate before injection. *Non-pregnant.* Ten cubic centimeters of diodrast was injected into the ear vein. Injection time was 3 seconds. Plates were made at 30 seconds, 1 2, 3, 4, and 5 minutes. The best plate was made at 4 min. tes.

*Non-pregnant with pressure.* Injected 4 hours plus after the first studies, with 10 cubic centimeters of diodrast. Injection time, 3 seconds. Plates were

### SUMMARY OF RESULTS IN RABBIT 4

	Low kidney				High kidney		
	Best plate time	Diastolic time	Filling time	Comments	Diastolic time	Filling time	Comments
Non-pregnant		7	22	Very faint		20	Faint
Non-pregnant pressure			Filled			22	Passed over vertebrae

taken at 3 seconds, 1 3, 4, and 5 minutes. The best plate was obtained at 3 minutes.

*21 days pregnant.* Ten cubic centimeters of diodrast was injected in 53 seconds. Plates were made at 5, 10, 5 and 20 minutes. The best plate was obtained at 10 minutes.

*21 days pregnant, with pressure.* Six cubic centimeters of diodrast was injected into the ear vein. Injection time was 1 minute, 54 seconds. Plates were made at 5, 10, 5, and 20 minutes. The best plate was made 1 minute.

### SUMMARY OF EXPERIMENT, RABBIT 4a

	Low kidney				High kidney		
	Best plate time	Diastolic time	Filling time	Comments	Diastolic time	Filling time	Comments
Non-pregnant				Excluded pelvis	1	Curve vertebrae	
Non-pregnant pressure			20			Filled	
21 days pregnant	20		Filled			Filled (heart)	
21 days pregnant pressure	20		1	Much more densely than without pressure	26	More densely than without pressure	

**Rabbit 5.** White shoulders and front legs. Plain plate previous to injection. *Non-pregnant.* Ten cubic centimeters of diodrast was injected into the ear vein in 43 seconds. Plates were made 1 43 seconds, 2, 3 4, and 5 minutes. The best plate was made 1 minute.

*Non-pregnant with pressure.* Injection of 10 cubic centimeters of diodrast into ear vein was made hour 35 minutes after first experiment. Injection time was 6 minutes. Pressure as applied for 6 minutes previous to taking of the plates. Plates were made 1 3 4 5 and 6 minutes. The best plate was made 1 5 minutes. Actually the best plate was obtained 1 minutes after the beginning of the injection. Most of the injection was given nearer to the end of the 6 minutes than to the beginning.

Rabbit died 4 days after the completion of the first experiment without becoming pregnant.

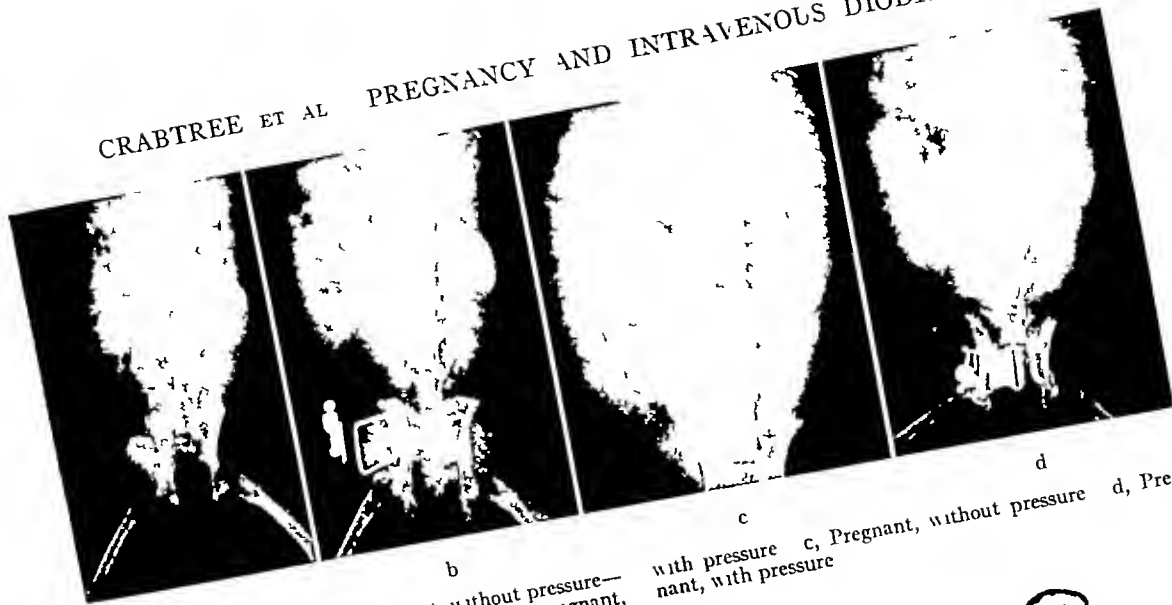


Fig 2 Rabbit 1 a, Non pregnant, without pressure—best plate, 3 minutes after injection b, Non pregnant, with pressure c, Pregnant, without pressure d, Pregnant, with pressure

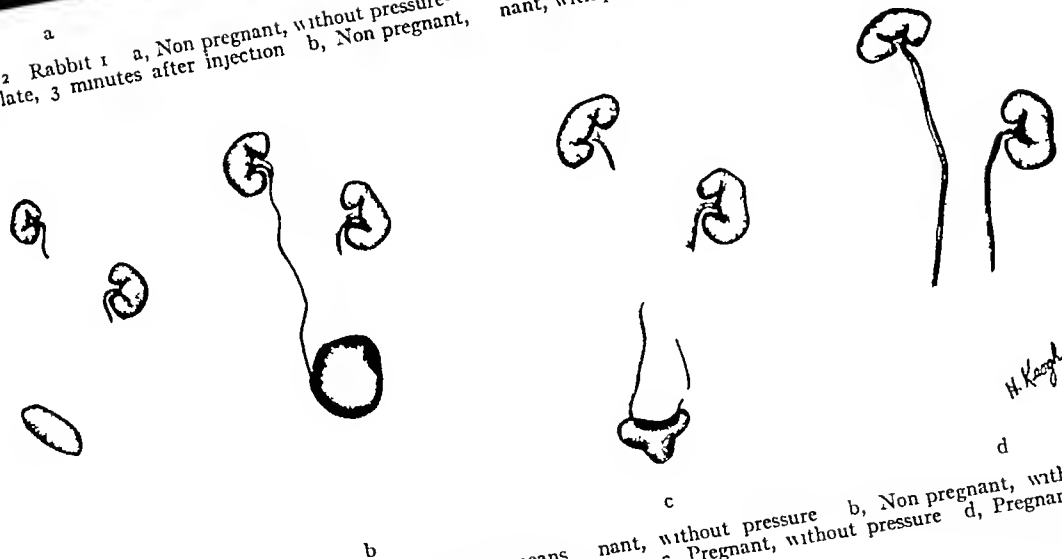


Fig 3 Rabbit 1 This drawing was made by means of caliper measurements from photographs, and shows the filling of the pelvis and of the ureters a, Non preg

# SUMMARY OF EXPERIMENT, RABBIT 5

	Low kidney				High kidney		
	Best plate min	Diameter mm	Filling mm	Comment	Diameter mm	Filling mm	Comment
Non pregnant	1	1	Filled		15	43	Passes over vertebra
Non pregnant pressure	5	1	23	Pelvis very full	15	Filled	

Rabbit 5b Replacement for Rabbit 5 Tag No 86 White with grey legs and back Plain plate previous

to injection Non-pregnant An injection of 10 cubic centimeters diodrast was made into ear vein, injection time, 18 seconds Plates were made at 18 seconds, 1 2, 3, 4, and 5 minutes The best plate was obtained at 5 minutes

Non-pregnant, with pressure The time of injection following first experiment is not recorded The injection consisted of 10 cubic centimeters of diodrast into ear vein, injection time, 16 seconds The plates were made at 16 seconds, 1, 2, 3, 4, and 5 minutes The best plate was obtained at 5 minutes

22 days pregnant Injection of 10 cubic centimeters of diodrast into ear vein, injection time, 20 seconds Plates made at 5 10 15, and 20 minutes The best plate was obtained at 20 minutes

2 day pregnant with press. Again 6 cubic centimeters of diodrast was injected immediately into heart. The plates were made at 5, 5, and 30 minutes. The best plate was obtained at 30 minutes.

## SUMMARY OF EXPERIMENT RABBIT 5A

	Low latency				High latency		
	Best plate min	Diastolic min	Filling min	Comment	Diastolic min	Filling min	Comment
Non-pregnant	1		44	Tapering		48	Tapering
Non pregnant with pressure			Filled	Shore of marked upward curve at base		51	Family
Pregnant	30		Filled			Filled	
Pregnant with pressure	30		Filled			Filled	Very fine curve noticeable only near pelvis

In this case, we doubt if there is as effective application of the pressure apparatus in the pregnancy pressure test.

Rabbit 6 Black-gray belly and white hocklers and legs. Plain plate previous to injection. Non-pregnant. An injection of 10 cubic centimeters of diodrast was made into ear vein injection time 30 seconds. The plates were made at 30 seconds, 1, 3, 4, and 5 minutes. The best plate was obtained at 1 minute.

Non-pregnant, with pressure Reinfected 1 hour and 40 minutes. Diodrast to the amount of 6 cubic centimeters was injected into the ear vein injection time, 5 seconds. The plates were made at 5 seconds, 1, 3, 4, and 5 minutes. The best plate was obtained at 3 minutes.

## SUMMARY OF EXPERIMENT RABBIT 6

	Low latency				High latency		
	Best plate min	Diastolic min	Filling min	Comment	Diastolic min	Filling min	Comment
Non-pregnant							
Non-pregnant with pressure			Filled			51	Found every loop of 25th vertebrae
days pregnant			30	None near bladder		57	
days pregnant with pressure	30		Filled	Family		Filled	

Calyces very well filled in pregnancy pressure experiment

2 days pregnant. Ten cubic centimeters of diodrast was injected into the ear vein injection time 30 seconds. The plates were made at 5, 10, 3, and 30 minutes. The best plate was obtained at 3 minutes.

2 days pregnant with pressure Interval from previous injection not recorded. 1 injection of 10 cubic centimeters of diodrast made into the ear vein injection time 3 minutes. The plates were made at 5, 10, 5, and 30 minutes. The best plate was obtained at 1 minute.

## CONCLUSIONS

1. Pregnancy changes in the urinary tract of animals, quadrupeds, cannot be expected to simulate pregnancy changes in women. The pressure factor is only slightly present in animals, if at all. Large ureteral dilatations are not to be expected in animals.

2. Ureteral dilatations have been recorded by veterinarians to be present in pregnancy in animals when stasis is produced through plugging of the ureters with blood, pus, and debris.

3. The effect of pregnancy in rabbits is to delay the appearance of the best plate after intravenous injection of diodrast and to fill the ureters considerably farther down toward the bladder than is seen in the non-pregnant animal.

4. Pressure even when applied for short periods of time influences the filling of the ureter and produces minor degrees of dilatation in pregnant rabbits. This modification of the physiology of the ureters is greater in the pregnant than the non-pregnant rabbit.

5. Rossi's contribution to the nature of the effect of pregnancy on the urinary tract in rabbits is worthy of support.

6. Present diametrically opposed views concerning the presence or absence of urinary tract changes in pregnancy in animals are based upon the erroneous concept that pelvic and ureteral dilatation in pregnancy in quadrupeds are the only indications of pregnancy change in the urinary tract which result from the pregnant state.

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# THE ROENTGENOGRAPHIC DIAGNOSIS OF LIPOMA

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**C**LINICAL differentiation of lipomas from other soft tumors, cysts, and collections of fluid is often difficult and occasionally impossible by ordinary methods of physical examination. Cysts and collections of fluid can usually be definitely established by aspiration with a needle. Light is transilluminated more readily through clear cysts than through lipomas and much more readily through lipomas than other tumors of soft tissues. Deeply situated tumors give greatest difficulties in differentiation. Accurate differentiation between sarcoma and intramuscular lipoma is essential to allow intelligent planning of treatment. Extensive surgical resection is usually imperative in the case of sarcoma while operation is more or less a procedure of election in the case of lipoma. Biopsy by aspiration or by means of the biopsy punch is frequently but by no means always, diagnostic.

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Fig. G. G. aged 6 years. A tender bulging mass of 3 months' duration in child's foot as diagnosed as sarcoma. The x-ray film shows swelling in the medial plantar aspect of the soft tissues. It is composed of central, solid, darkish radiolucent mass by 3.5 centimeters, surrounded by thin, hazy layer of slightly greater density. This is diagnostic of lipoma, which was found at operation. A correct diagnosis was not made due to lack of experience by the radiologist.

Roentgenographic examination will usually differentiate lipomas from other lesions due to the radiolucent appearance of fatty tumor in contrast with all other tumors. This radiolucent appearance results from the relatively lesser density of fat in comparison with the density of other soft tissues and tissue fluids. This fact is attested to by the common knowledge that fat floats on water while other tissues sink unless they contain air or gas. The relatively low density of fat results from a general constitution of  $C_{55}H_{100}O_2$  which is relatively rich in hydrogen the least dense of all elements. The proportionate constituents of protein are  $C_{57}H_{100}N_2O_2S$  which contains relatively more of the heavier elements oxygen, nitrogen, carbon, and sulphur.

Other tumors which contain a large amount of fat or cholesterol also cast relatively radiolucent roentgenographic shadows. Liposarcomas of the abdomen show a remarkably low radiographic density when one considers their gross size. The borders of a liposarcoma are usually more poorly defined than the borders of a lipoma and the fat may be deposited in multiple lobules but biopsy is necessary for accurate differentiation. Dermoid cysts contain cholesterol and allied alcoholic esters in combination with various fatty acids and therefore produce a relatively radiolucent density as described by Odquist. Dermoids occasionally contain imperfect teeth which permits an accurate roentgenographic diagnosis in such cases. Xanthomatosis, whether in soft tissues or in bones, produces lesions of less than average soft tissue density. Calcification is frequent in fatty tumors, usually occurring in areas of impaired blood supply or infarction. It is brought about by the formation of calcium soaps and later deposition of calcium carbonate and calcium phosphate in the disintegrating tissues.

Cavities of organs or soft tissue pockets which contain gas or air are the most radiolucent areas demonstrated in roentgenograms.



Fig 2 Mr F S, aged 44 years. An ovoid vaguely fluctuant submental mass showing gradual enlargement during 13 years was diagnosed clinically as a submental cyst. A roentgenographic diagnosis of lipoma was made on the basis of the submandibular ovoid, darkish, translucent area 2.5 by 6 centimeters, surrounded by a denser, whitish capsule and crossed by multiple fine trabeculations representing connective tissue septa. The roentgenographic diagnosis was confirmed at operation.

of the body. Differentiation from fatty tissues is made roentgenographically on the basis of the greater blackness of gas shadows, sharper margination, anatomical location, distribution in bubbles, and occasionally by associated fluid levels. Clinical observation will usually permit differentiation by history, compressibility, or crepitation.

Numerous authors have previously directed attention to the characteristic appearance of fatty tumors in the roentgenogram. Bufalini in 1925 was the first to point out the characteristic radiolucency of these tumors. Addi-



Fig 3, left. Mr J C, aged 39 years. A soft, freely movable lump below the right jaw had shown recent growth to 7 by 9 by 12 centimeters, suggestive of cystic tumor of salivary gland or lipoma. The roentgenogram showed the tumor to be radiolucent and surrounded by a slightly denser capsule, thus establishing a diagnosis of lipoma which was confirmed at operation.

Fig 4 J J, aged 4 years. A soft, semifluctuant orange sized mass in left supraclavicular region was suggestive of hygroma or branchiogenic cyst. The x-ray film shows a relatively radiolucent tumor, having clear-cut borders and spotted by patches and strands of slightly greater density indicating a fibrolipoma which was removed at operation.

tional reports and observations have been contributed by Moriconi, Laurell, Schulte, Odquist, Tagliavacche and Casanovas Reis, Chasin, and Templeton.

Laurell and Templeton have discussed the technical factors which are conducive to production of superior roentgenograms of fatty tumors. Soft tissue detail in small superficial



Fig 5 Mr H W, aged 60 years. A recurrent, large, firm, slightly nodular tumor on the right chest wall was suggestive of lipoma or sarcoma. The x-ray film shows a rather sharply delimited, relatively radiolucent mass, 15 by 20 centimeters, containing multiple small areas of calcification in its inferior portion. The roentgenographic diagnosis of lipoma was confirmed.



Fig 6 Mr S S, aged 61 years. A firm, slightly irregular tumor in the right breast was thought to be lipoma, carcinoma, or sarcoma. A plain x-ray of the mass shows a fairly well circumscribed, ovoid, relatively translucent shadow 9 centimeters in size. Subcutaneous and perimammary injection of carbon dioxide accentuates demarcation but without the distinct encapsulation of a fibroadenoma. A lipoma was diagnosed and removed.





Fig. 7 Mrs M G aged 55 years. An oval pendulous mass had gradually developed in right labia during 30 years. It had been diagnosed as hernia and repair as advised. The roentgenogram shows well delimited, relatively radiolucent, somewhat lobulated mass, 8 by 6 centimeters, containing few small areas of dense opacity. A diagnosis of lipoma with old areas of infarction and calcification as confirmed at operation.



Fig. 8 M E R aged 62 years. A deep, non tender firm mass had developed in the lateral aspect of the right hip and buttock during 5 years. The roentgenogram shows rounded, well circumscribed area of lower density over the proximal femur, arranging diagnosis of lipoma. A lipoma as resected from between gluteal muscles.

lessons is favored by the use of cardboard film holders low voltage between 35 and 50 kilovolts fine focal spot preferably about 1 millimeter in size and elimination of all motion during the exposure. In the examina-



Fig. 9

Fig. 9 Mrs L H 56 years. Lobular soft, freely movable masses, along lateral and medial aspect of right ankle, containing hard movable particles, suggested tenosynovitis and ganglion with rice bodies. X-ray films show masses to be radiolucent, encapsulated, crossed by fibrous septa, and with areas of calcification. A diagnosis of lipoma was confirmed.

Fig. 10 Mrs I W aged 60 years. The hamstrings had been previously amputated and the wound packed with petrolatum. Roentgenograms made 3 months later show rounded, well demarcated shadows of relatively lower density to be right of the hamstrings. The habit of the history thus represents a scar.

Fig. 10

# HUNT, BISGARD ROENTGENOGRAPHIC DIAGNOSIS OF LIPOMA

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tion of regions over 8 centimeters in thickness, better contrast is obtained by the use of fine grained intensifying screens instead of cardboard film holders. The Potter-Bucky grid aids in the clarification of detail through regions over 12 centimeters in thickness.

## SUMMARY

In a series of lipomas the clinical diagnosis was indeterminate while a positive diagnosis was possible on the roentgenograms. The rounded or ovoid radiolucent shadows cast by these tumors are pathognomonic of fatty tissue. Strands of increased density traversing the radiolucent mass represent septa and bands of fibrous connective tissue which vary in amount. Radiolucent soft tissue shadows are also cast by dermoids, xanthomas, liposarcomas, and aggregates of mineral or vegetable fats.

The differential clinical diagnosis in the case of the lipomas varies with the location. In the cervical region, one is led to consider thyroglossal cyst, branchiogenic cyst, hygroma, dermoid, salivary tumor, and sarcoma. In the breast, the possibilities of fibroadenoma, cystic mastitis, and carcinoma are presented. Along the extremities, tenosynovitis,

sarcoma, hemangioma, and abscess may be suggested. In the scrotal or labial region, hydrocele or hernia may be simulated by the translucent bulging mass. Also to be considered occasionally in differential diagnosis are sebaceous cysts, meningoceles, von Recklinghausen's neurofibromas, and cold abscesses.

On the basis of our experience, we recommend roentgenographic examination as being an accurate procedure in the differential diagnosis of lipomas from other soft tissue tumors.

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Fig. 1. Site of anastomosis is indicated on gill bladder and pectoral fins.

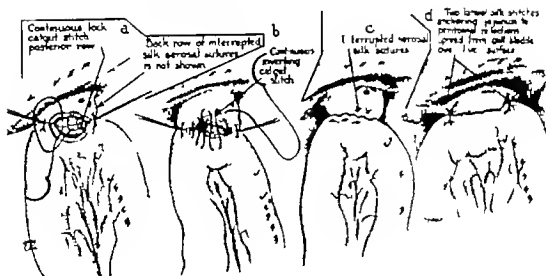


Fig.

# CLINICAL SURGERY

## CHOLECYSTJEJUNOSTOMY

As Opposed to Cholecystduodenostomy or Cholecystgastrostomy

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SOME years ago, in patients with obstructive jaundice due to carcinoma of the head of the pancreas or at the ampulla of Vater, I began the practice of anastomosing the gall bladder to the jejunum which was brought up over the colon at the hepatic flexure instead of performing cholecystgastrostomy or cholecystduodenostomy. This procedure has now been employed in a sufficient number of cases and over a sufficiently long period of time not only by myself but by the other surgeons in the clinic so that it may safely be presented as a method of sidetracking the bile from above the duct obstructed by malignancy into the intestinal tract. It is, at least in our hands, an operation which is easier to perform and one which is safer from the point of view of leakage than is anastomosis of the gall bladder to the stomach or anastomosis of the gall bladder to the duodenum.

There is an undesirable disproportion in the character of the thin walled distended gall bladder and the thick walled stomach with its heavy muscular rugæ at that portion of the stomach just proximal to the pylorus. Although bile introduced from the gall bladder directly into the stomach is well tolerated, as demonstrated by the number of cases in which this type of operation has been done, it is in general better to introduce the discharge of bile into the intestinal canal at some point beyond the pyloric sphincter. In re-operation upon patients who elsewhere had had the gall bladder anastomosed to the stomach we have several times seen the gall bladder and even the bile passages filled with gastric contents. While this feature of cholecystgastrostomy probably occurs only occasionally, nevertheless the fact that it does occasionally occur is disturbing and for this reason I began anastomosing the jejunum to the gall bladder.

The disadvantage of anastomosing the gall bladder to the duodenum is largely the danger of leakage because of its technical difficulties. In

establishing an anastomosis between the gall bladder and the duodenum a water tight connection must be made between these two structures, one of which, the duodenum, is practically a fixed structure, and the other, the gall bladder and its attached liver, a more or less movable one, capable of considerable range of movement particularly when vomiting complicates the picture. While this motion probably puts but little strain on the suture line, it is not the most favorable state of affairs.

The greatest disadvantage of cholecystduodenostomy is the fact that with a deeply situated duodenum and with an overhanging right lobe of the liver, as is occasionally noted at operation the technical difficulties of an accurate introduction of anastomotic sutures between the deep gall bladder and the deep duodenum are considerable.

If the jejunum is anastomosed to the gall bladder in place of either the stomach or duodenum, all of the disadvantages mentioned are largely avoided. With a long loop of jejunum pulled up in front of the colon at the hepatic flexure and the distended gall bladder emptied of its bile by a suction trocar, the two lax viscera can be dealt with at the level of the abdominal wall and a very accurate suture line completed around the opening in the gall bladder and the jejunum. Following the anastomosis the attached jejunum may be so rotated that the back as well as the front suture line may be inspected and reinforced if there is any evidence of sutures cutting out in friable gall bladders.

When the anastomosis is completed, a separate stitch is passed through a point just outside the fundus of the anastomosed gall bladder where the peritoneal coat of the gall bladder spreads out over the under surface of the liver. This stitch, then, catches the jejunum just beyond the point where that structure is anastomosed to the gall bladder. A similar stitch is placed on the opposite side between the jejunum and this fold of peritoneum where it passes off the gall-bladder wall. By this

plan, the jejunum is fixed to the liver and all tension on the suture line by the weight of the antecolic jejunum is removed. In addition, the jejunum is so fixed to the liver by these two suspension sutures that it ascends and descends freely with that structure.

We have had several patients with carcinoma of the head of the pancreas live 2 and 3 years following the employment of this procedure, long enough to determine that the discharge of bile

into this level of the intestinal tract is apparently as satisfactory as at the duodenal level.

#### CONCLUSION

The plan here described of anastomosing the gall bladder to a high loop of jejunum in place of to the stomach or duodenum has been used over a sufficient period of time so that it may safely be recommended both from a technical and physiological point of view.

# THE SURGICAL TREATMENT OF CHRONIC GASTRIC ULCER

## Review of 272 Cases

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THE results of properly performed surgical procedures in selected cases of chronic benign gastric ulcer are so satisfactory and the risk of operation is relatively so small when performed by competent hands that there should be little hesitation in recommending surgical treatment for all gastric ulcers which fail to respond promptly to medical management. We have recently reviewed 272 consecutive cases of chronic gastric ulcer in which surgical treatment was carried out at the Mayo Clinic from January 1, 1933 to January 1, 1937. There were 220 men and 52 women in the group. These patients were followed for a period of 1 to 5 years after operation, and this report is based on the findings in these cases.

In any study of gastric ulcers, one is immediately impressed by the vast difference between these lesions and ulcers of the duodenum. It is unfortunate and confusing that the similarity of the symptom complex of gastric ulcer to that of duodenal ulcer has led to a linking of the two conditions under the common title "peptic ulcer." As one of us (Walters 13, 14) has pointed out repeatedly, the lesions are dissimilar as regards the type of tissue in which they occur, their pathological nature, their physiochemical activity, and their response to medical and surgical treatment.

### INCIDENCE

Duodenal and gastric ulcers are the most frequent benign, surgical lesions of the gastrointestinal tract but, apparently, they occur less frequently in this country than abroad. Portis and Jaffé, as a result of 9,171 consecutive necropsies in this country, found the incidence of peptic ulcer to be 5.2 per cent, 196, or 2.9 per cent, were gastric and 158, or 2.3 per cent, were duodenal. Stewart, at Leeds, studied results from a series of 4,000 consecutive necropsies and found an incidence of 4.58 per cent of gastric ulcers and 6.81 per cent of duodenal ulcers. He estimated that more than 10 per cent of the population have peptic ulcer some time during life. The incidence of gastric and duodenal ulcer derived from studies at necropsy seems to be at considerable variance.

From the Division of Surgery, the Mayo Clinic

with the relative incidence of these lesions as found in living patients. According to Eusterman and Balfour at the Mayo Clinic, duodenal ulcer has been found about 10 times as frequently as gastric ulcer. Smithies, in a series of 1,725 cases of proved peptic ulcer, found 1,225 duodenal ulcers and 500 gastric ulcers, a proportion of 2.45 to 1.

Gastric ulcer is much more frequent among men than among women. According to Dibble, 72 per cent of gastric ulcers occur among men, 28 per cent among women. Smithies found the ratio to be about 2 to 1. In a clinical study, at the Mayo Clinic, the proportion of men to women was 3.9 to 1 and at necropsy, 3 to 1. In our series of 272 cases in which operation was performed, there were 220 men to 52 women, or a ratio of about 4.5 to 1.

### SITE OF LESION

Most gastric ulcers are found along the lesser curvature in the vicinity of the angle of the stomach. In Stewart's extensive studies, 3.5 per cent of the lesions occurred on the gastric side of the pyloric canal, 22.4 per cent were 1 to 2 inches from the pylorus, 34.1 per cent were 2 to 3 inches from the pylorus, 29 per cent were 3 to 4 inches from the pylorus, and 10.6 per cent were more than 4 inches from the pylorus. In 116 of 196 cases, or 59.1 per cent, reported by Portis and Jaffé the gastric ulcers were within 6 centimeters of the pylorus, 49, or 25 per cent, were more than 6 centimeters from the pylorus and less than 3 centimeters from the cardia, 12, or 6.1 per cent, were in the fundus, 4, or 2 per cent, were on the anterior gastric wall, and 3, or 1.5 per cent, were on the greater curvature. The majority of the lesions in our present series occurred along the lesser curvature close to the angle of the stomach (Table I).

Gastric ulcer, like duodenal ulcer, is subject to perforation and hemorrhage. When perforation of a gastric ulcer occurs, it is usually into the gastrohepatic omentum or toward the capsule of the pancreas. Both of these structures form an anatomic base to the ulcer and when perforation occurs, this base usually prevents complete per-

TABLE I.—SITE OF LESIONS (MAYO CLINIC SERIES)

Site	Men	Women	Total	Per cent
Lesser curvature, above angle	63	9	84	30.9
Lesser curvature, at angle	80	—	80	30
Lesser curvature, below angle	3	—	43	5.8
Posterior all	35	6	4	5
Greater curvature	—	—	4	5
Anterior wall	—	—	—	7
	20	5	27	00

formation with leakage of gastric contents into the peritoneal or lesser peritoneal cavity. Hemorrhage occurs not infrequently. Marshall and Kiefer found a history of hemorrhage in 1 per cent of their cases of gastric ulcer and in 18 per cent of their cases of duodenal ulcer. Smithies noted hemorrhage in 36.4 per cent of 500 cases of gastric ulcer. The hemorrhage was manifested by hematemesis in 80 per cent and by melena in 30 per cent. In our series, bleeding was manifest in 20 per cent of cases. Gastric ulcer, if in the prepyloric region may produce obstruction similar to that produced by a duodenal ulcer. Ulcers higher along the lesser curvature occasionally cause some obstruction due to reflex spasm of the pylorus. Occasionally gastric ulcer produces an hourglass stomach and this requires operation to relieve the obstruction produced between the fundus and antrum of the stomach.

The one major complication to which gastric ulcer is subject but to which duodenal ulcer is not subject is malignant changes. According to Stewart, gastric ulcers have a 10 per cent chance of becoming malignant. Smithies estimated that not more than 5 per cent become malignant, Labey 7 to 8 per cent and Katsch, 20 per cent. Since at present there is no way of knowing which gastric ulcers are subject to malignant change or which small ulcerating carcinomas may simulate both symptomatically and roentgenographically a benign gastric lesion, we firmly believe that all gastric ulcers must be considered malignant until proved otherwise and they should be treated surgically if they fail to respond promptly to medical management.

The question of whether an ulcerating gastric lesion is a carcinomatous ulcer, a carcinoma or an ulcer or a benign gastric ulcer is one which too often cannot be determined by the examining clinician, the roentgenologist or even the operating surgeon. Probably all gastric carcinomas begin as small lesions but we have no means of clinically determining when the malignant changes begin. In the early stages, when surgical treatment is most effective, all these ulcerating lesions of the stomach may give all the symptoms and signs of

benign ulcer with none of the distinguishing characteristics of a malignant lesion. Not infrequently the borders or base of an ulcerating gastric lesion show carcinomatous changes, although there have been no suggestions of malignancy by clinical or roentgenologic or even surgical examination. Microscopic examination is required to determine definitely the nature of these lesions. Frequently it is impossible to determine otherwise whether the lesions are ulcerating carcinomas or carcinomatous ulcers and whether the ulcer or carcinoma is primary. That is not of prime importance however. The fact remains that in patients in whom there is malignant change the treatment consists of wide excision of the lesion by partial gastrectomy.

#### INDICATIONS FOR OPERATION

When the symptoms have been of short duration, the lesion small and uncomplicated, and the patient less than 40 years of age, medical management as suggested by Ensterman, Jordan, and others may be indicated. If the pain is relieved the blood disappears from the stool, and the niche seen on roentgenologic examination disappears the patient may be considered to have a benign ulcer. However, even if the lesion does appear to be healing satisfactorily the patient must be advised to continue medical management at home and to undergo re-examination at least every 3 months. The examination should include careful roentgenoscopic examination of the gastric mucosa in every case. This should be supplemented with gastroscopic studies when possible. If, at any time there is any evidence that the lesion has not remained completely healed, surgical exploration should be advised. As McVicar has pointed out, one must constantly be on guard not to be led astray by temporary beneficial response to medical management, since small ulcerating malignant lesions may temporarily show signs of healing both clinically and roentgenologically.

The value of repeated careful roentgenoscopic examination of the stomach in cases of gastric ulcer cannot be overemphasized. However the limitations of this diagnostic procedure must be recognized. A definite roentgenologic diagnosis of malignancy usually proves to be correct but all roentgenologists agree that it is impossible roentgenologically to determine the benignancy or malignancy of the small ulcerating lesions of the stomach. It is enough that roentgenologic examination can determine the presence and site of lesions and, on repeated examinations, any changes in their size and character. Although the size and character of such lesions are subject to

# WALTERS, CLAGETT TREATMENT OF CHRONIC GASTRIC ULCER

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considerable variability (one of us, Walters, has seen gastric ulcers appear to change in size, as noted by comparing films over a period of 24 hours), such changes actually are not possible anatomically in so short a time. To depend on the roentgenogram for more than this will lead to a definite incidence of error in diagnosis, a lesion may appear to be a benign ulcer and yet be a cancer and the opportunity for cure may be lost due to the delay in recognizing its true nature.

As Moersch and Snell have pointed out, the use of the gastroscope in the diagnosis of gastric ulcer must assume a place secondary to roentgenologic examination. However, roentgenologic diagnosis is not infallible and gastroscopy should always be considered in patients in whom the clinical history is suggestive of a gastric lesion although the roentgenologic examination does not reveal any abnormality. Although the accuracy of roentgenologic diagnosis of lesions of the stomach is remarkably high, there is always a chance that a small lesion or one situated high in the stomach may be overlooked. Gastroscopy is also of considerable value in distinguishing between a benign gastric ulcer and a malignant ulcer and may offer valuable information as to the operability of the lesion. Gastroscopy is also a valuable aid in determining the effect of medical management on gastric ulcers. We do not feel that gastroscopy should be necessarily a routine procedure in all gastric examinations, but we have found it to be a very valuable adjunct to clinical and roentgenologic study of selected cases of known and suspected gastric disease.

Surgical treatment of chronic gastric ulcer is almost always indicated if the symptoms have been of long duration or have not responded to adequate medical management. Likewise, operation may be indicated if the symptoms are severe and disabling, even if of short duration. The same indications for surgical intervention in cases of bleeding, perforating, and obstructing gastric ulcers hold true as for similar duodenal lesions.

Because of our inability definitely to determine clinically or roentgenologically the malignancy or benignancy particularly of small ulcerating gastric lesions and because the surgical treatment is so satisfactory, we feel that operation is indicated in most cases of gastric ulcer if a trial course of medical treatment has been unsuccessful.

## OPERATIVE PROCEDURES

The ideal surgical procedure for chronic gastric ulcer is one which removes the lesion, eliminates

TABLE II —SURGICAL PROCEDURES USED IN THIS SERIES

	Totals
Excision of ulcer	14
Sleeve resection	10
Closure, acute perforation	3
Anterior gastro-enterostomy and entero-enterostomy	5
Anterior Pólya Balfour (partial gastrectomy)	9
Excision and pyloroplasty	9
Excision and gastro-enterostomy	50~
Posterior gastro-enterostomy	16
Billroth I (partial gastrectomy)	22~
Posterior Pólya (partial gastrectomy)	131~
Total gastrectomy	I
Gastrogastrostomy	I
Exploration	I
	272

pylorospasm, and alters gastric physiology to produce a marked reduction of gastric acidity, thus protecting against recurrence of ulceration. This is usually possible either by resection of the stomach or by excision of the lesion combined with gastro-enterostomy. However, other procedures such as simple excision of the ulcer or gastro-enterostomy have been followed by excellent results in selected cases. The operative procedures used on our series of cases are noted in Table II. Posterior Pólya resection was the operation used most frequently, 131 of the 272 patients having been treated in this manner. Knife or cautery excision of the lesion combined with gastro-enterostomy was used in 50 cases. Other procedures were used much less frequently but in some cases were used to good advantage when resection or excision and gastro-enterostomy were not feasible.

Simple excision of a gastric ulcer, although not an ideal surgical procedure because it does not provide for alteration of gastric function and gastric acidity necessary to prevent recurrence of ulceration, is frequently followed by surprisingly good results. Excision may be indicated occasionally if it can be done without interfering with normal peristalsis, and if the patient's general condition will not permit a more extensive operation. This procedure was performed 14 times in this series, cautery was used 5 times, and the knife, 9 times. The results were satisfactory. The average gain in this group was 15 pounds. One patient continued to have moderate distress of the ulcer type after operation and she believed that she had had one small hemorrhage. Eight of these patients experienced excellent results and 5 did not answer the questionnaire. Apparently the procedure gives good results in selected cases but we do not recommend it as a routine procedure.



Segmental or sleeve resection of the segment of the stomach in which the lesion is situated, with restoration of gastric continuity appears logical, for it removes the lesion with the least possible anatomic change. The disturbance of gastric peristalsis and lack of protection from subsequent ulceration, however make this operation less satisfactory than some others, in most instances. The procedure was performed 10 times in our series. The average gain was 20 pounds. Five patients were perfectly well without distress of any kind, 4 occasionally had slight distress, and only 1 had to follow a careful dietary regimen to prevent distress. We recently operated on a doctor who had the largest gastric ulcer we have ever seen. It had recurred after a sleeve resection performed elsewhere and had perforated with a crater base on the pancreas and on the undersurface of the liver making a mass 10 centimeters in diameter.

Gastro-enterostomy alone is not the operation of choice for gastric ulcer for by this procedure alone the lesion is not removed and one is still confronted by the possibility that the lesion may be malignant. The procedure may be indicated for large perforating lesions of the stomach when the patient's condition or age or the high position of the ulcer does not warrant a more extensive procedure. Gastro-enterostomy both anterior and posterior types, was carried out 21 times. Fourteen of these patients reported excellent health without distress of consequence and only 1 reported occasional, mild distress. There was no report from 5 of the group. There was 1 death. The average gain was 15 pounds.

Excision by cautery or knife combined with gastro-enterostomy is a very satisfactory procedure, for it removes the lesion and modifies gastric motility and secretory function and can be performed at very low risk. The lesion must be sufficiently small to lend itself readily to excision without encroachment on the pylorus. If conditions are such that excision combined with gastro-enterostomy is a formidable procedure, a resection is often preferable. Excision of the lesion with gastro-enterostomy was carried out on 50 patients. Twenty-nine answered the questionnaire. The average gain was 12 pounds. Twenty-seven were in excellent health, 1 had mild recurring distress, and the condition of another was only partially improved.

The operation which, in the greatest number of cases, most satisfactorily accomplished removal of the lesion and reduction of gastric acidity with maximal protection against recurrence of ulceration was gastric resection of the Pólya or Pólya

Balfour type. This procedure is preferable unless the lesion is so high that resection above the lesion is not technically feasible or if the condition of the patient is not good enough to stand such a formidable procedure. In our present series, the posterior Pólya resection was performed 131 times and the anterior Pólya Balfour 9 times. The results were extremely satisfactory. Fifty-five patients responded to the questionnaire. There was an average gain of 13 pounds. Eighty patients were in excellent health without distress. Five were in very good health with only occasional slight distress. There were 9 deaths in this group.

The Billroth I resection is a very satisfactory procedure if the gastric ulcer involves the pyloric third of the stomach and if resection can be performed with approximation of the stomach and duodenum without tension. Assisting in the performance of the operation, is a mobile duodenum. This procedure was performed 22 times in the series. There were 4 deaths in this group. Nine patients did not answer the questionnaire. 6 obtained very satisfactory results, and 3 continued to have slight distress. The average gain was 15 pounds.

In general, plastic operations on the pylorus with excision of the gastric ulcer do not give as good results as partial gastrectomy or excision of the ulcer and gastro-enterostomy, because the former procedure does not sufficiently hasten the emptying of the stomach or produce the desirable degree of reduction of gastric acidity. The procedure may be advisable if the lesion is on the anterior wall of the stomach just proximal to the pylorus, in which case excision and pyloroplasty may give satisfactory results. This operation was performed upon 9 patients in this series. Four obtained very satisfactory results. 5 did not reply to the questionnaire.

Total gastrectomy was performed upon 1 patient in whom a very high ulcer appeared to be malignant. Gastrogastrectomy was performed once closure of perforated ulcer 3 times and exploration, in only 1 case. There were only 16 deaths (15 men and 1 woman) in this series of 173 cases of surgically treated gastric ulcer a mortality of 5.88 per cent. The average age of the patients who died was 59 years. Pneumonia presents the greatest hazard to these patients. Ten of the 16 deaths in this series were due to pneumonia. In the past year however postoperative pneumonia has become a much less serious problem in these cases, for in salicypyridine with and without oxygen and serum therapy we have found therapeutic agents that have decreased materially

the mortality from postoperative pneumonia and we believe still further decreases in the dangers and seriousness of this complication will occur. There was 1 death due to coronary occlusion, a hazard beyond our control, and 1 due to pulmonary embolus. One death was attributed to peritonitis, 1 to duodenal fistula, and 2 to hemorrhage.

# RESULTS OF SURGICAL PROCEDURES FOR CHRONIC GASTRIC ULCER

Follow-up of these 272 cases of gastric ulcer was carried out by correspondence and the results were evaluated by the response to these letters. All the patients in this series had been operated upon from 1 to 5 years previously. It is interesting to note that only 1 patient in the entire group of 162 who answered the questionnaires classified himself as having a poor or unsatisfactory result. This patient had had a simple excision of the ulcer, a procedure we do not recommend.

The satisfactory results from the various types of procedures were approximately equal. This indicates that best results can be obtained by the use of a variety of surgical procedures, thus fitting the operation to the patient rather than the patient to the operation. It is also gratifying to note the excellent gain in weight and improvement in the general health of almost all of the patients. Gastro-enterostomy without excision of the gastric ulcer seemed to give the least satisfactory results in our series. However, as we have pointed out previously, on some occasions no other procedure is advisable or technically feasible.

In the entire series there was only 1 case of possible bleeding following operation and no cases of gastrojejunal ulcer were definitely proved following any of the procedures performed, however, as already noted, some patients in each group had some mild distress, at times.

This review shows clearly that the results of a properly chosen and properly performed operation for benign gastric ulcer are some of the best in the field of surgery and that disturbing symp-

toms or recurrence of ulceration is seldom encountered following operation.

## SUMMARY

A series of 272 cases of chronic gastric ulcer in which surgical treatment was employed have been reviewed and the results have been analyzed. The results of surgical treatment of chronic gastric ulcer are among the best in the field of surgery. Partial gastrectomy is the treatment of choice, but on proper indications, a variety of surgical procedures will give good results. Surgical treatment of gastric ulcer is indicated in any case in which response to a carefully controlled medical management fails to occur.

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## IDIOPATHIC SEGMENTAL INFARCTION OF THE GREATER OMENTUM

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**I**NFARCTS which occur within a localized segment of the greater omentum because of their exceedingly uncommon occurrence, are looked upon as unique surgical lesions. A search of the literature reveals the infrequency with which these lesions have been observed, diagnosed, and reported. Because of this rarity it seemed worth while to report a group of 6 consecutive patients from the Jewish Hospital who had omental infarcts and who were operated upon during the period from 1915 to 1939, all of whom recovered. Some of the theories which have been advanced to explain the etiology and pathogenesis of omental infarcts, also will be described and discussed. To do this satisfactorily one must have an accurate understanding of the anatomy and physiology of the omentum, the structure and function of this organ as it concerns the present paper will first be reviewed.

Cunningham describes the greater omentum as a large apronlike fold of peritoneum usually more or less loaded with fat, which is suspended from the transverse colon and hangs down in front of the intestines to a variable extent. When the abdomen is opened without disturbing the viscera, it is rare to find the greater omentum evenly spread over the front of the intestines. Most commonly it is folded in between some of the coils of intestine or tucked into the left hypochondrium or perhaps it is carried upward in front of the stomach by the distended transverse colon.

Numerous functions have been assigned to the great omentum: the chief seem to be (1) to act as a movable and easily adjustable packing material, capable of filling all temporarily produced spaces in the abdomen (2) to serve as a storehouse for fat (3) to be the great protector against peritoneal infectious invasions. Because it is freely movable it can travel to almost any part of the abdomen, and there build up barriers of exudate to check infections. It is because of this last property that it is often involved in many of the morbid changes which affect the intraperitoneal organs. In this way for example, either a portion or the entire omentum may become the seat of inflammatory, vascular or neoplastic changes. Pri-

mary lesions of the omentum, on the other hand, are relatively rare. A survey of the literature reveals only 2 cases of primary thrombosis of the omental venous system. Furthermore, the 2 cases cited are in reality not true instances of primary omental infarcts. In 1 case the entire portal venous system was involved and in the other congestive heart failure appeared to be the underlying causative agent of the omental infarct.

The case reported by Hines concerns a 54 year old male who complained of generalized abdominal pains of 2 weeks duration. The only positive finding on examination was a tender mass in the left upper quadrant, which at operation was seen to consist of omentum which contained multiple venous thrombi. The patient died of generalized peritonitis and at necropsy the superior mesenteric and splenic veins were found to be thrombosed, and the omentum was found to be the seat of numerous hemorrhagic infarcts. The second case in the literature is one reported by Berger. It concerns a 53 year old white male who was known to have arteriosclerotic, hypertensive syphilitic, cardiac disease for a number of years. The patient was admitted to the hospital during his second attack of congestive heart failure. At the time of his entrance he complained of severe sticking pains in the left upper abdomen. On examination the only objective finding was skin hyperesthesia. Clinical diagnosis of infarct of the spleen was made. The patient died 48 hours after entrance to the hospital. At necropsy the left third of the omentum was thickened, lusterless, and of a purple discoloration. A branch of the left gastropiploic vein was found thrombosed, the arteries were normal. There was, in addition, chronic passive congestion of the viscera and a small infarct of the spleen. The left ventricle of the heart contained a mural thrombus superimposed on a large healed infarct of the wall of the ventricle. Microscopically the omentum was the seat of extensive hemorrhages associated with an inflammatory reaction. The veins were occluded by thrombi composed chiefly of platelets, margined leucocytes, and conglutinated red blood cells.

The cases reported in this paper differ from those cited by Hines and Berger in that the infarct was confined to a small segment of the greater

omentum This was caused by a thrombus which caused occlusion of the vein draining the infarcted area The condition appeared rather suddenly in individuals who were otherwise known to be healthy

CASE 1 I S, a 63 year old male, was admitted to the hospital because of abdominal pain and constipation of 6 days' duration, and vomiting of 3 days' duration The pain at the onset was diffuse and generalized over the entire abdomen, intermittent, and colic like in character Three days later the pain localized in the right lower quadrant of the abdomen, became severe and more persistent, and was associated with vomiting of gastric contents There was no bowel evacuation during all this time, and enemas were ineffectual There was no history of any previous abdominal complaint, operation, or injury

On physical examination the patient appeared to be well developed and well nourished He was lying on his back with thighs flexed and was moaning with pain There was a moderate degree of abdominal distention, and exquisite tenderness, muscle spasm, and rigidity in the right lower quadrant The temperature was 99.4 degrees F, pulse 100, respirations 24, and blood pressure 160/95 The urine showed a faint trace of albumin, occasional white blood cells, and hyaline casts The blood count revealed 12,400 white blood cells, 81 per cent of which consisted of polymorphonuclear leucocytes and 19 per cent lymphocytes

The clinical impression was that of acute appendicitis for which he was operated upon through a right midrectus incision As the peritoneal cavity was opened, a mass of black, gangrenous omentum came into view The latter measured 8 by 12 centimeters, and was situated in the distal end of the greater omentum Careful exploration of the peritoneal cavity failed to reveal any other pathological changes A resection of the gangrenous segment was done and recovery was uneventful

Grossly, the resected portion of omentum consisted of a hemorrhagic mass of fatty tissue, it measured 8 by 12 centimeters On section, it was found to contain numerous small extravasations of blood and thrombosed blood vessels Microscopic examination of the specimen revealed an infarct of the omentum caused by thrombotic occlusion of its venous return

CASE 2 L W, a 53 year old female, was admitted to the hospital with the complaint of constant, severe, burning pain in the right lower quadrant of the abdomen of 4 days' duration The patient had experienced occasional intermittent but mild burning pains in the same area 6 months prior to the present admission Her past history was irrelevant she was an octipara and menopause occurred 2½ years ago

On examination, the patient was found to be a well nourished woman who was lying comfortably in bed The temperature was 99.8 degrees F, pulse 78, respirations 24, and blood pressure normal The mouth was edentulous and the tongue was coated The abdomen was very tender and spastic over McBurney's point The urine was normal, the blood count showed 10,000 white blood cells, and the differential count showed 82 per cent polymorphonuclear leucocytes and 18 per cent lymphocytes

The clinical impression was that of acute appendicitis At operation, through a right gridiron incision under spinal anesthesia the peritoneum was opened and a quantity of free serosanguineous fluid was found in the peritoneal cavity Adjoining the abdominal wound and adherent to the parietal peritoneum by a few fresh fibrous shreds, was a small segment of the distal portion of the omentum The latter measured 5 centimeters in diameter, was gangrenous

and of a blue black color, the appendix was normal Excision of the discolored omental segment was followed by uneventful recovery There was no pathological report of the specimen

CASE 3 H R, a 40 year old male, was admitted to the hospital with the complaint of pain in the right lower quadrant of the abdomen of 4 days' duration The pain was sharp, persistent, and non radiating Since the onset of his illness the patient had been constipated and enemas were ineffectual

On examination, the patient appeared to be well nourished and was lying quietly in bed The temperature was 100.6 degrees F, pulse 100, respirations 24 The only positive finding was exquisite tenderness and muscle spasm over McBurney's point The urine examination and blood Wassermann were negative The blood count showed 18,000 white blood cells, of which 83 per cent were polymorphonuclear leucocytes and 17 per cent were lymphocytes The clinical impression was that of acute appendicitis

At operation, through a right gridiron incision under general anesthesia, a mass of infarcted and inflamed omentum was found which was loosely adherent to the parietal peritoneum The appendix appeared normal Appendectomy and excision of the infarcted portion of the omentum was performed and recovery was uneventful Pathological examination of the segment of omentum showed a hemorrhagic infarct caused by thrombotic occlusion of its venous system

CASE 4 A D, a 52 year old male, was admitted to the hospital with the complaint of pain in the right lower quadrant of the abdomen of 2 days' duration and constipation of 6 days' duration, enemas were ineffectual The pain was constant, dull, and non radiating On the day of admission the pain became more severe and was exaggerated by any attempt at motion, coughing, or straining There was no history of previous operation or trauma In the past, the patient had always been well except for periods of constipation Nine years before the onset of his present illness he was said to have had Buerger's disease Following a slight trauma to his left foot the patient manifested symptoms of vascular disease of the lower extremities After a 3 year period of complete disability, a portion of the left hallux became gangrenous and a spontaneous amputation of the distal third of the large toe occurred Since then the patient has been completely free of symptoms

Examination revealed a well developed, obese male who was lying quietly in bed The temperature was 99.4 degrees F, pulse 90, respirations 22, and blood pressure 130/85 The essential physical findings consisted of slight abdominal distention, marked tenderness over McBurney's point, considerable local hyperesthesia, and a suggestion of muscle spasm in the right lower quadrant The terminal portion of the left big toe was absent and a healed scar indicated the site of the amputation There was no other finding indicative of a vascular disturbance in the extremities The urine was normal There was 13,500 leucocytes, 71 per cent of which consisted of polymorphonuclear leucocytes and 29 per cent of lymphocytes A flat plate of the abdomen showed merely gaseous distention of the large bowel The pre-operative diagnosis was acute appendicitis

At operation, through a right midrectus incision under spinal anesthesia, a small amount of free serosanguineous fluid was found in the peritoneal cavity The appendix appeared small and fibrotic Adjoining the abdominal wound there was found a mass of gangrenous omentum loosely adherent to the anterior parietal peritoneum Careful examination of the abdominal cavity failed to reveal any other pathological changes Appendectomy and excision of the involved portion of omentum was done and the patient made an uneventful recovery

TABLE I.—SUMMARY OF CASES

Case No.						
Age	43	33	40	33	37	47
Sex	M	F	M	M	M	F
Duration of symptoms, days	6					
Pain at start	Diffuse R.L.Q.	Localized R.L.Q.	Localized R.L.Q.	Localized R.L.Q.	Localized R.L.Q.	Localized R.L.Q.
Tenderness	Yes	Yes	Yes	Yes	Yes	Yes
Rigidity	Yes	Yes	Yes	Yes	No	Yes
Vomiting	Yes	No	No	No	Yes	No
Constipation	Yes	No	Yes	No	Yes	No
Temperature, degrees F	99.4	99	100.6	99	99	99.1
Distention	Yes	No	No	Yes	No	Yes
W.B.C.	13,500	10,000	18,000	13,900	9,300	9,000
Pre-operative diagnosis	Acute appendicitis	Acute appendicitis	Acute appendicitis	Acute appendicitis	Acute appendicitis	Acute appendicitis
Postoperative diagnosis	Indirect of duodenal	Indirect of duodenal	Indirect of duodenal	Indirect of duodenal	Indirect of duodenal	Indirect of duodenal

\*R.L.Q. right lower quadrant.

Grossly the excised portion of omentum consisted of an irregular mass of red and black, yellow, adipose tissue, measuring 7 by 4.5 by 3 centimeters. The surface as covered by prominent blood vessels. The cut surface as mottled dark blue and black, the consistency as firm.

Microscopically there are found numerous engorged blood vessels and extravasated blood. Some areas are infiltrated with small and large monocytes and polymorphonuclear leucocytes. The appendix showed mild inflammatory changes.

CASE 5. P.O. 37 year old male, as admitted to the hospital with the complaint of pain in the right lower quadrant and vomiting of 48 hours' duration. The pain as sharp and constant and grew progressively more in character. There as no history of any previous abdominal disturbance, operation, or injury. His health in the past had been excellent.

Examination revealed an obese male as lying in bed with the thighs flexed on the abdomen. His marked tenderness in the right lower quadrant of the abdomen and immediately around the umbilicus. The temperature as 99.6 degrees F., pulse 90, and respirations 16. The urine as negative. The white blood cell count as 9,000, the differential count showed 78 per cent polymorphonuclear leucocytes and 5 per cent lymphocytes. A diagnosis of acute appendicitis as made.

At operation, through McBurney incision under spinal anesthesia, quantity of serousanguinous fluid as found in the peritoneal cavity. The appendix as bound down in the right iliac fossa. The free border of the omentum showed an area of gangrene. In appendectomy its excision of the gangrenous portion of omentum as done; recovery as successful.

Grossly the excised portion of omentum measured 3 by 4 centimeters in size. It as of deep red color and leading to it was thrombosed blood vessel. Microscopically it showed diffuse hemorrhagic extravasations and the also excluded its fresh thrombi. The appendix as essentially normal.

CASE 6. A.C. 47 year old female, entered the hospital with the complaint of pain in the right lower quadrant of the abdomen of 3 days' duration. The pain was sharp and

as aggravated by the ingestion of food. There as no history of any previous abdominal disturbance, operation, or injury. Menses are normal. She as an octupara and had had no miscarriages.

On examination, the patient was found to be well developed and nourished. The abdomen as distended. There as tenderness and rigidity in the right lower quadrant. The temperature as 99.8 degrees F., pulse 90, and respirations 16. Urine findings and blood count are normal. A diagnosis of acute appendicitis as made.

At operation, through right midclavicular incision, portion of the greater omentum as found discolored red and blue and adherent to the parietal peritoneum. A thrombosed vein as found. As its free edge the appendix appeared normal. An appendectomy and resection of the discolored portion of omentum as done. The patient made an uneventful recovery.

Grossly the appendix as normal. The omentum measured by 3 centimeters. It as firm and red and black in color. Microscopically it showed hemorrhagic or thrombotic and areas thrombosis.

Of the 6 cases reported in this paper 4 were males and 2 were females. The ages of the patients in this series ranged from 37 to 63, with an average age of 48.6 years. The onset of symptoms was acute in all 6 patients. In only 1 instance was there history of occasional slight burning pain in the right lower quadrant of the abdomen for period of 6 months preceding the acute onset. The average duration of symptoms before operation varied from 3 to 7 days. Pain localized in the right lower quadrant was the most outstanding symptom in all cases. In 1 instance the pain in the right lower abdomen was preceded by generalized abdominal pains.

The character of the pain varied. It as described as cramplike by 1 patient, sharp by 3,

burning by 1, and dull, followed by sharp exacerbation shortly before operation by another. The pain was intermittent in 1 patient and constant in all the others. Motion, coughing and straining aggravated the symptoms in 2 instances and the intake of food in 1. Nausea and vomiting were present in 2 patients and constipation was a prominent symptom in 3 patients. None of the patients presented an antecedent history of intra-abdominal operation or trauma.

Physical examination in all 6 patients revealed well developed and well nourished individuals. 2 were obese. The average temperature varied from 100.6 to 100.8 degrees F., in 1 instance it was 100.6. Three patients showed exquisite local abdominal tenderness and skin hyperesthesia while the remaining showed a lesser degree of tenderness. In 3 of the patients there was found local rigidity of the abdominal wall, 2 had muscle spasm in the right lower quadrant, and in 3 others distention was present.

The white blood cell count was normal in 2 patients, in the others it was elevated and ranged between 10,000 and 18,000 per cubic millimeter. The differential count showed 71 to 83 per cent polymorphonuclear leucocytes and the remainder were lymphocytes.

The pre-operative diagnosis in all 6 patients was acute appendicitis. At operation, 3 patients showed serosanguineous fluid in the peritoneal cavity. There was a striking similarity in the pathological picture all 6 patients presented, it consisted of a hemorrhagic infarct involving a small segment of the terminal portion of the right side of the omentum. The infarcted area varied in size measuring 3 by 4 centimeters to 8 by 12 centimeters. In 4 instances the affected portion of omentum was adherent to the anterior parietal peritoneum by a plastic exudate. The infarcted omentum presented itself at operation as a blue, red, and black mass, markedly thickened and firm in consistency, and sharply demarcated from the surrounding omental tissue. The veins were prominent and in 3 instances there was macroscopic evidence of thrombosis of the veins in the infarcted omentum (Fig. 1).

Microscopic examination of the specimens again showed the same histological picture in all patients. It consisted of congestion and thrombosis of the venous channels, and hemorrhagic extravasations into the omental fat. The thrombi were relatively fresh and consisted largely of platelets, margined white blood cells, and agglutinated erythrocytes. There was, in addition, a mild inflammatory reaction, in which the exudate consisted for the most part of small and large mono-



Fig. 1. Photograph of hemorrhagic infarct in segment of omentum. Note the sharply demarcated area of infarction from the surrounding omental fat.

cytes, polymorphonuclear leucocytes, and plasma cells. In 2 instances there were also found numerous lipophages, the latter varied considerably in size and some averaged as much as 20 times the size of a normal leucocyte. The lipophages were round, polygonal, or oval in shape, the cytoplasm was pale and finely granular and the nucleus was relatively small and round. Some of the cells contained more than one nucleus. These cells resembled very closely in appearance the so-called "pseudo xanthomatous" or foam cells. Scattered between these cells were congested capillaries and a variable number of polymorphonuclear leucocytes (Figs. 2 and 3).

In a general way, it may be said that the symptoms of omental infarcts mimic those of acute appendicitis. Pain in the right lower quadrant of the abdomen is more or less a constant feature, and is described as sharp, colicky, and burning in character. Another striking symptom in the syndrome of this disease is the disproportion between abdominal tenderness, the duration of symptoms, and abdominal rigidity. The abdomen is usually widely and definitely tender to deep palpation and the abdominal rigidity is not nearly as marked as one might expect it to be when the possible duration of the complaint and definite tenderness are considered. Another outstanding symptom of this disease is the very marked hyperesthesia of the skin which is not commonly seen in other acute intra-abdominal lesions. The normal leucocytic relationship is only moderately disturbed. The temperature range in the uncomplicated picture is low. Unless the possibility of this condition is kept in mind it will be very difficult to recognize it as a definite surgical problem, although surgery offers a very excellent prognosis. Appendicitis is perhaps the disease most likely to be con-



Fig. 2. Omental infarct, showing section of vein, the lumen of which is obliterated by thrombotic mass, and the surrounding omental fat diffusely infiltrated with hemorrhagic extravasations and some round cell infiltration. X85.



Fig. 3. Infarct of the omentum showing infiltration of the tissues with large foam cells or macrophages. X 75.

lized with infarction of the greater omentum. The changes enumerated herewith are so constant and typical as to form that if not a clinical, at least a pathological entity is always suggestive.

#### EVALUATION

Many and varied suggestions have been offered to explain the etiology of omental infarcts. All investigators agree that the necrosis of tissues follows strictly in the path of and is confined to, the thrombosed vascular areas. In regard to the immediate mechanism of this thrombosis, there is no uniformity of opinion. In a general way it may be said that more than any one causative factor may be responsible for the production of local thrombosis in individual cases. It would be of interest in this connection to enumerate the various conditions under which local thrombosis may develop in the omental veins.

Thrombi may be liberated from some distant point into the general circulation and later become arrested in an omental vein as an embolus. Such a condition however is unlikely to occur unless one assumes the presence of an arteriovenous aneurism of the omental vessels. Moreover there was no evidence in any of the cases here cited of a lesion existing elsewhere in the body from which thrombi might become detached.

One of the patients whose case is cited in this paper (Case 4) was said to have had thrombo-angitis obliterans of the lower extremities, which was followed by spontaneous amputation of the toe several years previous to the development of the omental infarct. Since Constantinesco has reported cases of mesenteric thrombosis and infarction which followed on the heels of thrombo-

angitis obliterans, it was felt at first that the thrombosis of the omentum in our case might be explained on a similar mechanism. However, pathological examination of the specimen showed no evidence of an existing thrombo-angitis of the epiploic veins. Such a hypothesis, therefore may be completely disregarded as it concerns the present case.

Venous thrombosis in torsion of the omentum is a well recognized entity (4, 6). The condition is caused by a sudden twisting of the omentum that results in acute circulatory disturbances. If the twist is not reduced immediately the structures distal to the lesion become gangrenous. If infection does not supervene the aseptic gangrene is subsequently organized into a mass of fibrous tissue that leads to complete disappearance of the involved omental tissue. This explanation, especially as it concerns this series of cases, is open to question. None of the patients in the series described herewith showed at operation any evidence of a twist in the omentum. Furthermore the infarct was situated in a portion of the omentum where torsion does not occur because of mechanical conditions.

In a series of experiments conducted by one of us (8) it was shown that a forceful pull on the jugular vein in the rabbit which injured its endothelial lining resulted in the formation of a clot at the site of the injury. Furthermore if the lumen of the vein distal to the point of injury was partially constricted so as to retard the flow of blood through the vein thrombosis occurred more promptly. There was a striking resemblance to the character of the thrombus thus produced experimentally to that seen in the infarcted omentum. Both types of thrombi were composed of platelets, margined leucocytes, and agglutinated

red blood cells. In the light of such experimental findings it is the authors' belief that the mechanism involved in the formation of omental thrombosis is similar to that which is produced experimentally. We believe that a possible stretching of an omental vein may occur consequent to some trauma, and this in turn leads to the formation of a thrombus.

It is of interest to note in this connection some of the experiments conducted by Nario. He ligated the right and left gastro-epiploic vessels close to their union with the superior mesenteric and splenic veins, respectively. As a result there were produced within 20 minutes multiple milary infarcts and hemorrhagic extravasations in the omentum. He also reports a case of multiple infarcts of the omentum in a woman who died of pressure within the omental veins favors the development of marantic thrombosis. It is also a well recognized physiological fact that the epiploic veins become engorged with blood during the process of digestion. Animal experiments have shown that such venous congestion is most pronounced at the more dependent free margin of the omentum where the marginal veins cross. It seems then that a temporary retardation in the flow of blood through the omental venous circulation occurs during the process of digestion. An injury to the endothelial lining of the vessel during this phase, is likely to incite local clotting within the omental vein. Such a conclusion is also in harmony with the experimental findings reported by one of us (J R), of which mention has already been made.

Various terminologies have been applied to this disease, some of which do not characterize the pathological changes which underlie this condition. Thus, under the heading of "primary acute epiploitis," Eliason and Johnson described a series of cases which in reality are infarcts of the omen-

tum. The term itself "acute epiploitis," as this condition has been called by them, implies that the etiological factor is localized in the omentum and is of an inflammatory nature. Specifically, the term epiploitis is therefore, a misnomer, since it signifies that the condition is inflammatory, for which there is little supportive evidence. The pathological description of their cases is typical for that of infarction produced by torsion, and not of inflammation. It is true that an inflammatory cell reaction of variable degree is commonly seen in association with the infarct in the omentum, but such a finding is not at all uncommon in infarcts that occur anywhere in the body.

#### SUMMARY AND CONCLUSIONS

- 1 Six consecutive cases of infarcts of the omentum, in which recovery has occurred following resection of the infarcted segment, are analyzed as a basis for the discussion of problems associated with this lesion.
- 2 The difficulty in making a diagnosis arises from the fact that the clinical picture is not pathognomonic. Similar clinical pictures may result from other acute intra-abdominal lesions, of which acute appendicitis heads the list.
- 3 The symptomatology, etiology, and pathogenesis of the disease are generally discussed.

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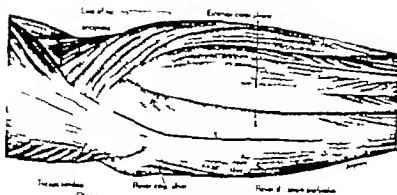


Fig. 1. Line of incision.

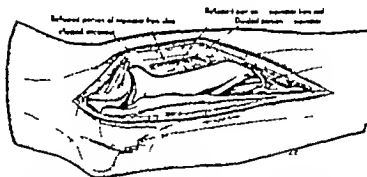


Fig. 2. Complete exposure of the upper third of the ulna, upper fourth of the radius, and radioulnar articulation.

*Surgical Exposure of Ulna and Proximal Third of Radius through One Incision.*—Harold B. Reid

# SURGICAL EXPOSURE OF THE ULNA AND PROXIMAL THIRD OF THE RADIUS THROUGH ONE INCISION

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**E**XPOSURE of the upper third of the radius without trauma to the deep branch of the radial nerve is difficult to obtain by the incisions in popular use. The approach herein described provides an excellent view of the upper third of the radius and, if required, of the entire length of the ulna, while ample protection is afforded this important motor nerve.

## THE APPROACH

The incision is begun in a direction  $\frac{3}{4}$  inch proximal to the tip of the olecranon on the external border of the triceps tendon and is extended downward along this structure to its insertion into the olecranon, thence is continued along the radial side of the subcutaneous triangle, which forms the dorsal surface of the olecranon, to the apex of the triangle. From this point the incision follows the dorsal border of the ulna distally, if necessary, to the styloid process. On the radial side of the incision are the anconeus and extensor carpi ulnaris muscles, while on the ulnar side are the distal portion of the triceps tendon and the flexor carpi ulnaris and flexor digitorum profundus muscles (Fig. 1).

The insertion of the anconeus and origin of the supinator muscles are elevated subperiosteally from the dorsal surface of the ulna, as are also the origins of the abductor pollicis longus, extensor carpi ulnaris, and extensor pollicis longus muscles throughout the extent of the incision. Stripping of these structures, being subperiosteal, is accomplished with ease. The deep muscle fibers of the supinator which arise from the triangular depression below the radial notch are next divided close to the ulna.

The muscular flap may now be retracted radially to expose the radiohumeral articulation, the head and neck of the radius, and that portion of the shaft above the upper margin of the interosseous membrane (Fig. 2). If further exposure of the radius is desired, the dorsal interosseous artery may be ligated at the upper margin of the membrane and the muscular flap reflected subperiosteally from the ulna down to the interosseous membrane, thence laterally along the dorsal surface of the membrane to the radius. In this man-

ner, slightly more than the upper third of the radius may be exposed without disturbing the deep branch of the radial nerve.

To appreciate the protection afforded the deep branch of the radial nerve by this approach, one must understand the relation of the nerve to the supinator muscle. The nerve enters the forearm through the superficial and deep planes of the supinator muscle, thus, when this structure is detached from its origin and elevated from the neck and upper portion of the shaft of the radius, the nerve is protected by the deep plane of the muscle. Figure 3 illustrates the course of the nerve through the supinator muscle. The numbers 59, 60, 61, and 62 indicate the levels of the corresponding cross sections in Figure 4. From the location of the nerve and the line of the incision as demonstrated in these cross sections, it is obvious that the nerve remains safe in the substance of the reflected supinator muscle.

This approach has been used in the treatment of 9 patients, its extent being varied in each to meet individual requirements. Seven of the patients had fractures of the ulna with dislocation of the head of the radius. In these, the incision is ideal, in that it affords adequate exposure for internal fixation of the ulnar fracture, reduction of the head of the radius, and restoration of the annular ligament. While making the approach, a strip of deep fascia, 4 to 5 inches in length and  $\frac{1}{2}$  inch in width, may be elevated from the forearm and left attached at its junction with the perios-

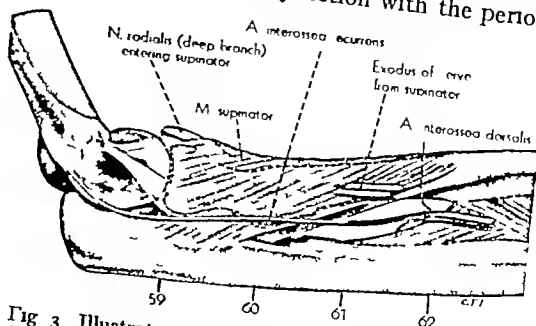
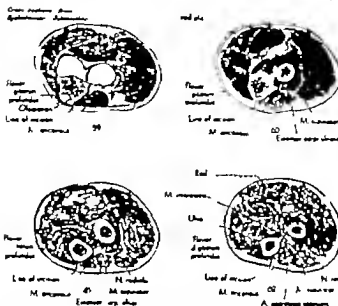


Fig. 3. Illustrating the relation of the deep branch of the radial nerve to the superficial and deep planes of the supinator muscle. The numbers 59, 60, 61, and 62 indicate the levels of the cross sections shown in Figure 4.



# CONGENITAL RECTOVAGINAL DEFECTS

## Operative Repair

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THE principal considerations in the operative repair of congenital rectovaginal defects are (1) to close the fistulous opening, (2) to repair the perineal defect, if present, (3) to remedy associated developmental defects, usually those due to imperfect development of the proctodeum or of the post-allantoid hindgut

### EMBRYOLOGY

In order to understand fully the anatomical situation found in the case herein described, it will be worth while to review briefly the developmental anatomy of the genitorectal apparatus. A thorough knowledge of the embryology explains the numerous other anomalies of the region in a rational way and integrates an apparently heterogeneous group of situations

The mucosa of the intestinal canal is derived from entoderm with the exception of its oral and anal extremities. It is enveloped by a layer of mesoderm which divides into two portions, forming the peritoneum and the muscle and connective tissue of the gut wall (2)

In the 3 to 5 week embryo, the hindgut and the allantoic stalk are united caudally in a communal dilatation, the cloaca (4) (Fig 1). That portion of the hindgut later forming caudad to this union is called the postallantoid hindgut and descends toward the proctodeum

The cloaca is divided at about 9 weeks into an anterior and a posterior portion by the descending urogenital membrane (urorectal septum). The interior portion (from the allantois) becomes the urachus, urinary bladder, and genitalia. The

posterior portion becomes the rectum. The proctodeum is established opposite the postallantoid rectum and becomes the anus and its external sphincter

As the rectum proceeds caudad, the proctodeum invaginates until the attenuated intervening membrane ruptures. We see diagrammatically (Fig 3) the situation just before this occurs (5). The rectum is well formed and is nearly ruptured through the proctodeum. From the urogenital sinus has projected the uterovaginal anlage, and the urogenital membrane has become a substantial perineum

The following statements now become self-explanatory (1) A persistence of the cloacal intercommunication will leave an opening between the rectum and any of the derivatives of the allantois: urethra, bladder, vulva, vagina, and uterus (2) A defect in the caudal portion of the urogenital membrane will result in a rectoperineal fistula (3) Incomplete or imperfect downgrowth of the postallantoid hindgut may cause the rectum to end blindly to be united to the proctodeum by a cord, or to exhibit variable degrees of stricture (4) An imperfect development of the proctodeum may cause a persistent anal membrane, complete or incomplete. The proctodeum is rarely entirely absent. These four types of anomalies may occur singly or in any combination

Because the existence of the proctodeum is independent of the development or even the proximity of the terminal gut, it follows that in the

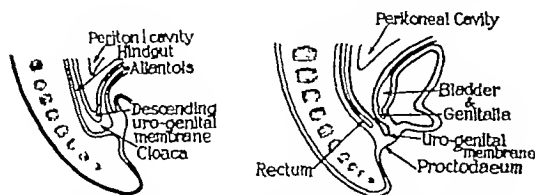


Fig 1 left Median section of a 9 millimeter embryo  
Modified from V C David

Fig 2 Median section of a 12 millimeter embryo  
Modified from V C David

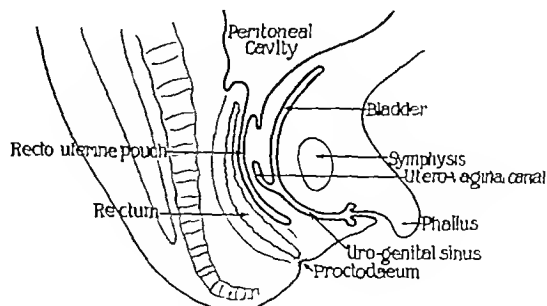


Fig 3 Median section of a 50 millimeter embryo  
Modified from Keibel and Mall

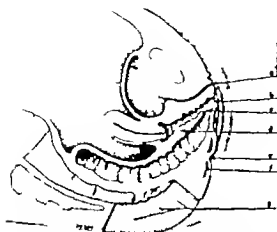


Fig. 4. Schematic drawing showing location of fecal and first stage of operation. a, urethra; b, vaginal outlet; c, rectal opening; d, rectovaginal septum; e, dimple / sphincter and exterior; f, incision; g, removal of coccyx.

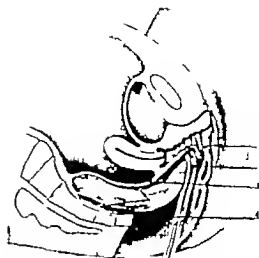


Fig. 5. Mobilization of the rectum. a, Rectal opening; b, site of division; c, peritoneum; d, space developed about the rectum by means of blunt dissection.

majority of rectal atresia the anal dimple and surrounding actively functioning sphincter are present (2). Thus, if operative repair is successful adequate sphincter control ensues.

#### INCIDENCE OF ANOMALIES

A brief survey of the literature reveals wide variation in the statistics quoted by various authors. In 66,654 deliveries, three cases of imperforate anus were noted (3). Berman, writing in 1938 reports 2 anomalies in 34,454 admissions to the Riley Hospital in Indianapolis. This probably is not an accurate determinant of the proportion in the population at large. He quotes Hall, who found about one anomaly in 5,000 births. David states that the incidence is between 1/5,000 and 1/10,000. Webb records 1/7,581 (Ziemendoff) and 1/9,000 (Veff). So we see that the figures vary from Berman (about 1/600) to Zochter and Collins (about 1/22,000). The actual figure is somewhere between these two. Certainly at any rate, the general surgeon will only exceptionally see a large series of cases.

Of Berman's 23 cases, only 5 were similar to the one reported. However in imperforate anus with vaginal rectal outlet the vast majority of openings is in the vulva. There have been relatively few examples of rectovaginal communication above the vestibule (8).

#### CASE REPORT

J. C. aged 3 year 8 months, of Italian parentage, was admitted to the hospital September 3, 1933. Nineteen

months previously she had been brought to the out patient department at the age of 3 years because of constipation and the fact that her mother had attempted to give her enemas and could find no anal opening. There was no previous family history. One sibling died at birth—was said to be premature.

Delivery 1 term as normal. Her birth weight 2636 pounds. Her first tooth appeared at 6 months, but at 1 year she sat up for the first time and on admission had not yet uttered or babbled. She had had hooping cough but no other diseases of note.

In the out patient department, it was noted for the first time that there was no anal opening and that the stools were passed through the vagina. It was decided to postpone surgery until the infant was sufficiently developed. She was therefore seen in the clinic, receiving dilatations from time to time and making satisfactory physical progress. An x-ray study of the rectum was made by injecting the contrast medium through a catheter inserted into the vaginal opening. The findings indicated congenital translocation of the anal canal near the internal sphincter.

Examination on admission to the hospital revealed fairly well developed and nourished infant. Her skull facial expression, enable, all as stand above. There are present 8 upper and 6 lower teeth. No cardiac abnormalities are noted. The abdomen is distended, soft, tympanic, but no masses are found. Fecra are being discharged from the vagina with some difficulty. The anus is absent but there was slight dimpling in the anal area at which puckered when the child cried.

The Mantoux and Wassermann reactions are negative. The urine is not abnormal. The leucocyte count is normal. The erythrocyte count was 3,600,000, hemoglobin 60 per cent (87 grams per 100 cc.).

The diagnosis as congenital rectovaginal communication, congenital imperforate anus, and mental deficiency.

On September 5, 1933, under ether anesthesia repair of the fistulous communication was attempted (R. F.). An incision was made in the midline of the perineum from the posterior vaginal margin toward the anal dimple. This

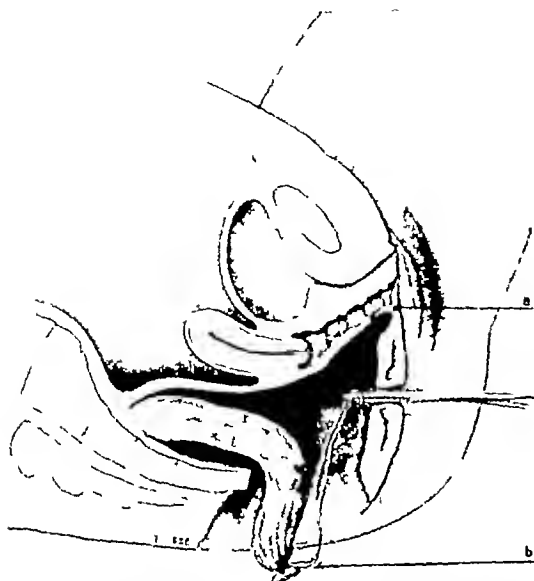


Fig 6 Rectum tied off and ligature grasped with clamp inserted through anal incision *a*, Rectal opening, *b*, rectal end

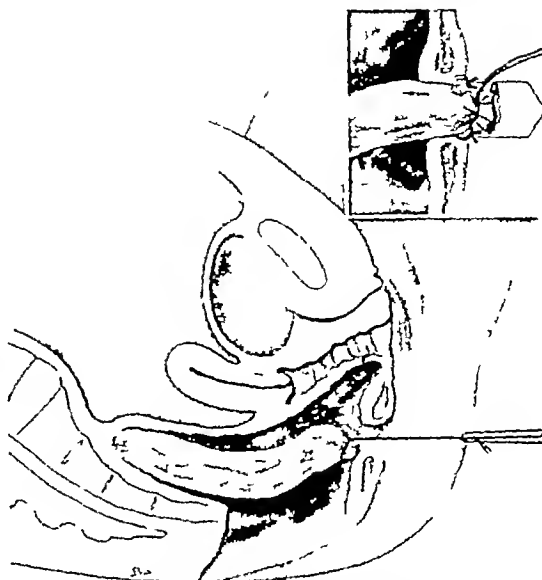


Fig 7 Rectum being drawn through new opening Inset shows the method used in sewing the rectum to the anal skin

exposed the vaginal outlet and the rectal opening was found to be on the posterior inferior vaginal wall just inside the posterior commissure. A longitudinal septum was seen to divide the vaginal cavity into two lateral compartments.

The perineal incision was continued forward around the rectal opening which was then separated from the vagina. The rectum was depressed backward and its mucosa was sutured to the skin of the perineum. The levator muscles were united between the vagina and rectum and the closure was finished in the usual perineorrhaphy fashion.

Subsequent bowel movement forced the levator muscles apart, and feces were discharged through the extent of the wound. The posterior portion eventually united, leaving the situation essentially as it was at the outset.

Two years later, on October 28, 1936 she was readmitted for observation. She had been treated in the clinic, receiving dilatations and for the previous 8 months had had one daily stool without medication and with fair control. She was classified as a mentally deficient microcephalic and was discharged without treatment.

At the age of 6 years and 4 months (May 11, 1938) she was re-admitted because of constipation. The stools were passed through the vagina with great difficulty and the aid of mineral oil. Psychometric studies classified her as a mentally defective imbecile grade. The following day, under ethyl chloride and ether anesthesia, operation was again performed (R. F. C.). The patient was placed in the Sims' position, left side downmost. A linear midline incision was made over the terminal sacral segment and the coccyx and carried downward to within an inch of the anal dimple (Fig. 4). The coccyx was removed in the usual fashion. The rectum was separated from the vagina anteriorly by blunt dissection. The separation was continued laterally about the rectum and with a finger inserted into the anus, down to its exit in the posterior vaginal wall. It was also freed from the anterior aspect of the sacrum and from the adjacent peritoneum of the pouch of Douglas (Fig. 5).

The terminal rectum was doubly clamped and cut with a cautery. The proximal stump was tied with a ligature, left long. A stellate incision was made through the skin dimple, taking care not to injure the sphincter, and a clamp was put through the muscle, grasping the ligature on the end of the apparently normal rectum (Fig. 6). The rectum was then pulled through the stellate incision and the clamp holding the vaginal opening from behind was released and withdrawn (Fig. 7). The coccygeal incision was closed in layers with a small drain at the lower angle. The patient was then put up in lithotomy position. The rectum was sewed to anal skin (Fig. 7, inset Fig. 8) and the previously made vaginal opening enlarged longitudinally. A typical perineal repair was accomplished (Fig. 9). The skin was closed with interrupted catgut sutures (Fig. 10).

The postoperative course was uneventful. On the sixth day she became moderately distended, but feces and gas were passed adequately after a manual dilatation. On the ninth day, she was having spontaneous bowel movements and was comfortable and afebrile.

Following discharge, she showed little ability (or desire) to control movements and 3 weeks later was re-admitted for dilatation under anesthesia. This was done with the liberation of a large amount of fecal material.

Subsequently she was dilated under anesthesia four times in 6 months. There was a lapse during this interim of 2 months when no dilatations were attempted because of a severe intercurrent rheumatic carditis. Because of this, apparently, she developed an anal fecal fistula. The recto-vaginal communication remained closed.

The mental deficiency contributed to the postoperative difficulty in handling the dilatation of the anus necessary in these patients. Under normal circumstances digital dilatation of the new anus should be carried out twice weekly and without the use of an anesthetic. In this instance an anesthetic was used to avoid the strain upon the heart caused by the struggling of the patient while being held for the dilatation.

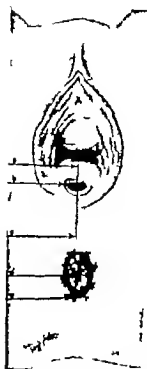


Fig. 8. Longitudinal incision through original perineal opening and incision of rectal opening; *a*, sutured rectum; *b*, suture of rectum to anal skin.

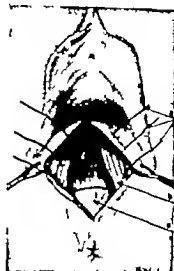


Fig. 9. Perineal repair; *a*, Sutures to approximate levators; *b*, levator ani muscle; *c*, rectum.

It is best to wait until a child is at least in its second year of life before an attempt is made to repair a congenital rectovaginal defect. Operation fails to effect a cure in 90 per cent of cases and the mortality is high in the newborn ( ).

In some instances a narrow communication will close spontaneously if the rectal opening be well established; at any rate dilatations can be safely repeated until operation is justified.

If dilatation is not adequate, colostomy can always be resorted to. When in doubt, do a colostomy; probably good advice when taken.

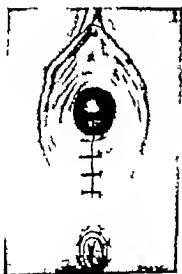


Fig. 10. Appearance at end of operation.



Fig. 11. Photograph taken 30 days after operation. Patient content for gas and feces.





# TUBAL STERILIZATION BY THE MADLENER METHOD

## A Critical Analysis of Failures

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**N**O method of sterilization upon the human female has stood the test of time at least occasional isolated cases of failure have marred the previously perfect records of each. Even supravaginal hysterectomy does not offer a positive safeguard against subsequent pregnancies. Liepmann reported an abdominal pregnancy primary tubal, occurring in a patient 2 years after supravaginal hysterectomy with excision of an intraligamentous cyst. An even more remarkable incident was reported by McMillan and Dunn, in which two pregnancies occurred in the same patient within 3 years after supravaginal hysterectomy with excision of all of one fallopian tube and ovary and most of the other tube, leaving in only one ovary and about one and one-half inches of the fimbriated end of the corresponding fallopian tube, and stitching these remaining organs in with the peritoneum that was drawn over the stump of the cervix.

The Madlener method, which was introduced in 1919 (4) became the most popular method of sterilization on the obstetrical service of the Johns Hopkins Hospital in 1936 for several reasons (1) it offered a relatively bloodless operation at the time of cesarean section or during the early puerperium, (2) it could be carried out in a shorter period of time and the operative time thereby reduced (3) it seemed to be a method which could be safely performed by any surgeon, irrespective of how little his surgical experience (4) its incidence of failures as reported in the literature in general was quite low and (5) it offered the easiest tubal method by the vaginal approach. Our use of the method has borne out each of these contentions except that in our hands its percentage of failures has been high. One hundred and one sterilizations were performed by this method (31 in 1936 43 in 1937 and 27 in 1938) and 4 cases we have witnessed 5 clinical failures, as evidenced by a subsequent intra-uterine pregnancy beginning 6 (Case 1) to 30 (Case 4) months after sterilization in each of 5 patients.

Eighty-eight sterilizations were accomplished by the abdominal route and 13 by the vaginal.

Forty-seven were performed in conjunction with term and 7 with premature classical cesarean sections. Fifteen were done at the time of interruption of pregnancy by abdominal hysterectomy. Twelve were performed abdominally during the first 3 weeks of the puerperium and 30 as interval operations, the average period following the termination of a pregnancy being 37 weeks and ranging from 5 weeks to 4 years. The indications for Madlener sterilization are listed in Table I, while the salient clinical features of the cases in which the operation failed are shown in Table II. Gross and microscopic findings of the fallopian tubes in the latter cases follow:

**CASE I.** L. G. No. 3549. C. B. 557. When the abdomen was opened in order to resect the patient, many adhesions were found, among these the apex of the knuckle of right fallopian tube where it had previously been sterilized by the Madlener method, to the lateral pelvic wall. The left adnexa were free of adhesions and there appeared to be a thin area made up of little more than post-contracta at the junction of the proximal and middle third of the tube.

The resected portion of the right fallopian tube was made up of the knuckle and short proximal and distal portions of more normal appearing tube, but the whole part of tissue measured only 3 centimeters in length. The hole of this block, as serially sectioned.

The left tube was represented by 1 piece of tissue. One as the outer one-third of the tube and presented normal ampullary portion and fimbriated end on both external surface and cross section. The middle portion of this fallopian tube measured 4 centimeters in length and consisted from its inner thick end, compressed and thinned area began but extended for distance of only 5 millimeters. This thinned area, plus small region of each proximal and distal extremity as serially sectioned.

**Microscopic pathology.** The left fallopian tube was patent lateral to the thinned area and represented the relatively normal ampullary portion of the tube. The site of the previous sterilization contained no tubal lumen, its expected site as replaced by solid scar tissue (Fig. 1). Some strands of the black silk suture were seen in these sections but there was no evidence of any foreign body reaction.

The right fallopian tube as patent lateral to the previously knuckled knuckle although even here the lumen was smaller than normal and as lined with low type of epithelium, which was not thrown up into complicated folds, but rather represented the type of tubal lumen seen in the interstitial portion of tube. The knuckle of the tube as made up of large masses of scar tissue. The small tubal lumen as seen in some of this scar tissue and at the opposite side of the tube as another and solid area of scar tissue, which was thought to represent the adherent lumen of one arm of the knuckle (Fig. 2). Medial to

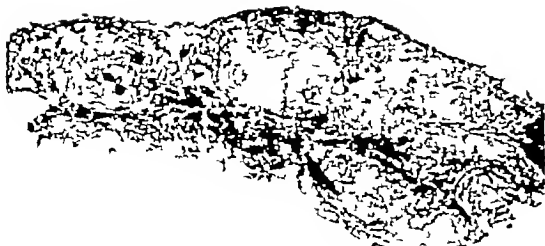


Fig 1 Case 1 The thinned area of the left fallopian tube showing no evidence of a tubal lumen, but its former site occupied by a solid area of scar tissue  $\times 7$

the knuckle the tubal lumen was patent and presented a picture essentially the same as that lateral to the knuckle. As the lumen was followed up along the medial side of the knuckle, eventually a point was reached where the lumen communicated with the external surface of the tube (Fig 3), and lateral to this region for a short distance no tubal lumen was present

In summarizing, the cause of failure in sterilization by the Madlener method in this case cannot be found in the left fallopian tube. The only explanation for the resulting pregnancy is found in the tuboperitoneal fistula on the medial side of the ligated knuckle of the opposite (right) fallopian tube. Apparently a process of endosalpingiosis occurred on the medial side of the ligated knuckle of this tube and extended outward toward the region where the knuckle was adherent to the lateral pelvic wall. Sampson has shown that this process can extend into other organs that are adherent to a traumatized fallopian tube.

The sites of sterilization in this patient were apparently the junctures between the inner and middle one-thirds of the tubes, and since Madlener (4) originally stressed the selection of a site where the tube was freely movable, at its mid-point or lateral to this, it may be assumed that failure followed the improper selection of the sites for ligature as well as the traumatization of the serosa of the right fallopian tube.

CASE 2 O McC No 127700, C W 5634 At the time of the second sterilizing operation, the left fallopian tube was said to have shown gross evidence of salpingitis, was densely adherent to the left ovary, and still assumed the knuckle shape formed at the previous operation. The silk ligature could be identified. The right fallopian tube and ovary also evidenced signs of old salpingitis, but nowhere could the site of sterilization be seen and this tube (right) was thought responsible for the subsequent pregnancy.

The right fallopian tube was small and presented a thinned area 4 centimeters from the uterine cornu and 1.5 centimeters from the lateral end of the tube, the fimbriated end was not present. The left fallopian tube was somewhat



Fig 2 Case 1 One half of section through the ligated knuckle of the right fallopian tube, showing chiefly scar tissue, but also scattered areas of smooth muscle. This probably represents the replaced lumen of one arm of the knuckle. The other one half of this section shows a small and abnormal tubal lumen in a large area of scar tissue  $\times 7$

longer than the right and was adherent by fine old adhesions to the anterior surface of the ovary. This tube was rather normal in appearance except for one nodulated area covered by adhesions and still containing the suture used to ligate this tube. This ligature was located 5.5 centimeters from the uterine cornu and 3 centimeters medial to the normal fimbriated end.

*Microscopic pathology.* The right fallopian tube presented a patent lumen throughout. The latter was rather characteristic of the outer isthmic portion except that the folds of epithelium were either absent or small and few in



Fig 3 Case 1 High power magnification of a part of the section across the medial side of the knuckle of the right tube, showing the small and abnormal lumen communicating with the external surface of the tube. The subsequent pregnancy is believed to have occurred by way of this tuboperitoneal fistula  $\times 65$



Fig. 4. Case 1. Section across the ligated knuckle of the left tube, showing an adequately patent tubal lumen, with epithelial folds characteristic of the fallopian and the mesosalpinx surrounded by thick layer of scar tissue. At the opposite end of the knuckle, note the large cavity in an area of scar tissue, lined by connective tissue and representing the degenerated arm of the ligated loop of tube. Between these two areas there is a large area occupied by lymphocytes, silk suture material, debris, and foreign body giant cells (Fig. 3) X64.

number at the rough approach the mesosalpinx. Here also, the serosa and tubal musculature are thinner than elsewhere and thinner than normal, with the tubal lumen approaching more nearly the serosal surface. There is no evidence of the ligature or of foreign body reaction in any section.

The left fallopian tube, again, is patent throughout, but somewhat larger than the right, with tubal epithelial folds more characteristic of the ampullary region. In the region of the knuckle there is a cavity opposite the lumen, which corresponded in size and shape to the tubal lumen, but as lined with connective tissue that as thrown up into small folds and seemed to represent degenerated arm of the crushed and ligated loop (Fig. 4).

There is no doubt that the right fallopian tube was traumatized at the time of Madlener sterilization, but the presence of a complete lumen with absence of the non-absorbable suture and foreign body reaction, leads one to suspect that the suture either slipped off or cut through the ligated knuckle. Again, since the left tube was traumatized and ligated, one arm degenerating partially while the other was preserved rather than possibly regenerated some flaw in crushing or tying the knuckle of this tube is suggested. While pregnancy in this case certainly could have occurred by way of either fallopian tube, the left was most likely the offender for here we observed a larger and more normal lumen and the corpus luteum of pregnancy was located in the left ovary. On the other hand, careful mensuration of the fetus left little room for doubt that the pregnancy existed at the time of sterilization and in all

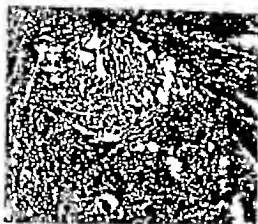


Fig. 5. Case 1. High power magnification of the serosal area seen in Figure 4, showing lymphocytes, foreign body giant cells, and silk suture material X64.

probability the fertilized ovum had passed the region of ligature very probably already implanting in the uterine cavity. Thorough curettage should have recovered the fertilized ovum and most certainly microscopic examination of the curetted endometrium would have aroused the suspicion of an existing pregnancy.

CASE 3. O. M. No. 203. C. W. 5608. Abdominotomy for the second sterilizing operation, each tube as marked aside only on account of the presence, near its mid point, of a loop of black silk which as so located as to give the impression of having been placed in the tubal musculature and serosa directly opposite the mesosalpinx. That portion of each tube marked by the silk suture as removed before the sterilization operation as outlined by the Irving method.

Each block of fallopian tube measured roughly 1 centimeter in length and normal appearing tube lay beneath least of black silk suture material in the serosa opposite the mesosalpinx. The hole of each as serially sectioned, after the suture material had first been removed.

*Affected peritubal pathology.* The right fallopian tube as patent throughout, but the lumen as smaller than normal. The lining epithelium arched from low cuboidal to typical columnar. In some respects it as thrown up into simple folds, whereas elsewhere there are ill-defined folds. Moreover, nowhere did it give the characteristic appearance of the ampullary portion of tube, but rather that of the isthmic or isthmic portions. In all sections the muscular coat as thickened and scarred and one did not observe the typical inner circular and outer longitudinal layers of smooth muscle. Lateral to the mesosalpinx and particularly in the direction of the mesovarium, there as considerable scarring. The only evidence of foreign body reaction as in the occasional small nest of lymphoid cells.

The left fallopian tube as very much like the right, but the lumen as generally slightly larger and the lining epithelium as thrown up into more numerous but simple folds. In one region there are several secondary laminae border the main lumen, but all lined with similar epithelium (Fig. 6). Inspection of the serial slides in this



Fig 6

Fig 6 Case 3 Cross section of the left tube. In this photomicrograph are shown, besides the usual lumen, several secondary lumina, i.e., pockets or pouches of the true lumen  $\times 8$

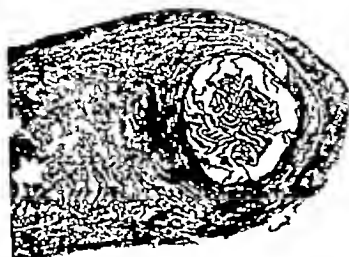


Fig 7

Fig 7 Case 4. Section across the left fallopian tube, showing a lumen resembling the normal isthmic portion of a tube, but approximating a large area of scar tissue. The opposite end of tissue contained no tubal lumen, was

region showed that these secondary lumina represented pockets or pouches in the true tubal lumen

The whole picture of these fallopian tubes was not suggestive of sloughing off of the ligated knuckles with fusion of the liberated ends, but rather one of partial or complete destruction of the original tubal lumina, with a regeneration and recanalization of each. It seems highly probable that in this case the knuckles of fallopian tube were inadequately ligated, too loosely, perhaps, with the ligatures slipping off and the traumatized tubal epithelium regenerating.

CASE 4 A P No 152744, C W 5715 On inspection of the fallopian tubes at the time of laparotomy to resterilize the patient, it appeared that the right tube was satisfactorily occluded. The two bisected ends of this tube could be seen through the peritoneum and appeared to be several millimeters apart, with their ends well sealed. There was a labyrinth of veins just beneath this area, so it was not resected but Irving sterilization was carried out proximal to the site of the previous sterilization. The left fallopian tube appeared normal except for a speck of black silk suture material which could be seen through the peritoneum. This strip was resected and the distal end of the proximal portion, like that on the opposite side, was buried in the musculature of the anterior uterine wall.

The specimen of fallopian tube measured 2 centimeters in length and contained a small piece of black suture material in the peritoneum opposite the mesosalpinx. The suture material was removed and the specimen was placed in a single block for serial section.

*Microscopic pathology* The left fallopian tube was patent throughout. The lumen was generally rather large and the epithelium and its folds characteristic of the isthmic and ampullary portions of a normal fallopian tube. Many of the epithelial folds were, however, large, contained scar tissue and were infiltrated with some leucocytes and lymphocytes. These folds appeared to arise from the side adjoining the mesosalpinx while at the opposite side there



Fig 8

made up of scar tissue, and probably represented a degenerated arm of the ligated knuckle  $\times 7$

Fig 8 Case 5 Section across the distal end of the ligated knuckle of right tube, showing a relatively normal cross section of ampullary portion of tube. The opposite end of tissue is made up of solid scar tissue and represents the terminal end of the opposite and degenerated arm of the ligated knuckle of the tube  $\times 8$

were very few epithelial folds and these were quite simple, many of them being short and represented only as epithelial buds (Fig 7). In the area showing the greatest effect from trauma, there were several pockets in the tubal lumen and one of these pouches was incompletely lined with epithelium. Medial to this point, the lumen again became unilocular, but more like the inner isthmic portion of a fallopian tube.

Madlener sterilization was apparently effective on one side, the right. However, in all probability crushing and tying of the left fallopian tube was inadequate, producing partial destruction of the tubal epithelium in the ligated knuckle, followed by regeneration of the tubal lumen.

CASE 5 A P No 113149 C W 5738 At the time of the second sterilizing operation, both fallopian tubes appeared to have re-established their lumina, but the sites of previous Madlener sterilization could be identified by remaining portions of the black silk suture.

The resected portion of the right fallopian tube presented what appeared to be a loop with a piece of black silk suture around one arm of the loop, the suture appeared to have cut through the other arm of the loop, leaving a thin and fibrotic portion of fallopian tube.

The resected portion of the left fallopian tube was analyzed with difficulty, since the whole specimen was less than 1 centimeter in length. However, it also contained black silk suture material, which was apparently around both arms of a loop of tube.

*Microscopic pathology* The serial sections of the right fallopian tube revealed varying pictures with rapid transitions. On the medial side of the loop there was an area of scar tissue and smooth muscle, which contained a canal lined with low cuboidal epithelium. This layer was not complete and there was no evidence of epithelial folds. Immediately adjoining the ligated loop on its medial side, the tubal lumen disappeared and was completely replaced by scar tissue, thus successfully interrupting the tubal lumen. In the region of the ligated knuckle there were two separate and distinct areas of scar tissue, each containing

TABLE 1—INDICATIONS FOR STERILIZATION BY THE MADLENER METHOD

	Cases
Hypertension, scula disease and chronic nephritis	20
Repeated cesarean sections	6
Rheumatic heart disease	5
Psychiatric indications— Febrile convulsions	7
Insanity	6
Idiocy	5
Multiparity with agonal relaxation	4
Repeated toxemias of pregnancy	—
Grand multiparity	—
Pulmonary tuberculosis	—
Brochial asthma	—
Previous pneumectomy	—
Cerebral arteriovenous aneurysm	—
Previous extensive agonal repair	—
Old polyomyelitis	—
Rectovaginal fistula	—
Congenital heart disease	—
Sickle cell anemia (severe)	—
Carcinoma of cervix	—
Extensive stricture of rectum	—
Total	—

evidence of small and abnormal tubal lumen one fifth pocket-like outgrowth. Toward the distal end of the loop of 1 be, this arm showed increasingly more normal tubal lumen and epithelium until it joined the normal outer half of the fallopian tube (Fig. 8). The opposite arm of the loop remained in a state of partial degeneration.

The left fallopian tube as represented in actual section clearly as four times and it as much smaller in cross section than is normal fallopian tube. There as evidence of smooth muscle tissue. In each section there as small but abnormal tubal lumen lined with epithelium. In some it as quite small and presented very rudimentary epithelial folds. In one region there were several pockets in the lumen, each of which as at least partially lined with a type of epithelium. In other regions the lumen as larger but the epithelium folds no taller.

It seems most likely that the crushing and ligation of the right fallopian tube was adequate with complete scar tissue replacement of the tubal lumen on the medial side of the knuckle. Even though the lumen of the left tube was patent throughout, it was so small in certain regions that descent of an ovum through it would seem unlikely. Yet the pregnancy must have occurred by way of it. The fact that pregnancy did not recur until 13 months after the Madlener sterilization might indicate that after inadequate crushing and tying of this loop, that period of time was necessary for recanalization and regeneration of the tubal lumen.

The only other known failure of sterilization performed by other methods in the history of the obstetrical department is that of Case 6. Failure in this instance was obviously due to an oversight

on the part of the operator for at the time of the second sterilizing operation there was no evidence that excision of the right cornu had been previously attempted. Moreover the attachment of the round ligament to the uterus on this side as intact thus eliminating the possibility of mistaken identity with sterilization attempted on the round ligament instead of the fallopian tube. The period of sterility following the Madlener operations which failed ranged from 5½ to 20 months.

Just how frequently failure of Madlener sterilization is due to the formation of tuboperitoneal fistulas, to re-establishment of the originally occluded lumen by endosalpingiosis, to the development of a new lumen outside the ligated knuckle or to failure to interrupt the tubal lumen properly cannot be ascertained from the literature. Microscopic descriptions of such fallopian tubes from the human are scarce. The 3 cases reported by Adair failed on account of the formation of a fistula in one tube of each. The cause of failure in both cases reported by Rubowits and Kobak was endosalpingiosis. In one instance the ligature had cut through an arm of the loop of fallopian tube while in the other the new tubal lumen was situated beneath the ligated knuckle through the mesosalpinx. Neubauer, Koehler and Vignes, each of whom has described the microscopic appearance of fallopian tube in which Madlener sterilization failed, attributed the occurrence of a subsequent intra-uterine pregnancy to recanalization of the lumen. Since Sampson has shown that endosalpingiosis occurs even in fallopian tubes not traumatized by operative procedures, we assume that it must be a relatively common condition following Madlener sterilization and wonder how long after the sterilization it is possible for endosalpingiosis to proceed and thus endanger the security of the operative procedure. Neubauer believed that a tubal pregnancy occurring 6½ years after a Madlener sterilization operation was possibly due to recanalization of the tube. The number of failures from Madlener sterilization should be reduced by more careful adherence to the technique as originally laid down by Madlener (4). The development of tuboperitoneal fistulas should be avoided by the proper selection and use of the crushing instrument. Madlener (4, 5) has stoutly contended that a dull clamp with broad crushing area of millimeters, is the only safe instrument to employ. Further to avoid breaking through the serosa while crushing the loop to paper thinness, the clamp must be applied squarely. Madlener (4) suggests the inclusion of a bit of mesosalpinx and the selection of a loop of

TABLE II—BRIEF ANALYSIS OF CASES

Case No	Age Race Parity	Indications for sterilization type and time of main operative procedure	Type of sterilization postoperatively course resulting sterile period	Second operative procedure	Cross pathology of fallopian tubes	Microscopic pathology of fallopian tubes	Cause of failure of Madlener sterilization
1 L C	34 Black Multi para	Hypertensive vascular disease abdominal hysterotomy 14 weeks gestation	Madlener bilateral Uneventful discharged 13th day 14 months	Tubal resection with Irving sterilization Classical cesarean section term	Right—knuckle adherent to lateral pelvic wall left—thinned area	Both tubes occluded but tuboperitoneal fistula on medial side of one	Small tuboperitoneal fistula following endosalpingiosis right tube
O McC	32 White Multi para	Multiparity post minor colpotomy 4 mos after term spontaneous delivery	Madlener bilateral Uneventful discharged 5th day None	Hysterectomy salpingectomy oophorectomy 16 <sup>1</sup> / <sub>2</sub> wk. gestation	Right—thinned area Left—ligated knuckle adherent to ovary	Both tubal lumina adequately patent throughout corpus luteum in left ovary	Pre existing gestation but little evidence of trauma to either ligated area
3 O M	18 Black Secundipara	Rheumatic valvulitis classical cesarean term	Madlener bilateral Febrile 5 days discharged 15th day 5 <sup>1</sup> / <sub>2</sub> months	Tubal resection with Irving sterilization low cervical cesarean section term	Black silk in serosa opposite mesosalpinx in each normal appearing tube	Both tubal lumina adequately patent throughout	Sutures slipped off and traumatized fallopian tubes regenerated
4 A P	29 Black Multi para	Rheumatic valvulitis classical cesarean section term	Madlener bilateral Uneventful discharged 16th day 30 months	Tubal resection with Irving sterilization hysterotomy 22 weeks	Right—not resected left—black silk in serosa opposite mesosalpinx	Left tubal lumen adequately patent throughout	Suture slipped off left tube allowing regeneration of the traumatized tubal epithelium
5 A P	23 White Primigravida	Rheumatic valvulitis with hypertension classical cesarean section at 35 weeks gestation	Madlener bilateral Eclampsia pyrexia discharged 28th day 13 months	Tubal resection with Irving sterilization hysterotomy 11 weeks	Black silk suture around one or both arms of ligated loops of tubes	Right lumen occluded but small lumen patent throughout left tube	Occlusion of both tubal lumina but recanalization of one by endosalpingiosis
6 L J	27 White Multi para	Feeble-mindedness classical cesarean section term	Cornual excision (?) bilateral Uneventful discharged 10th day 21 months	Salpingo-oophorectomy unilateral with term radical cesarean section	Left—cornual region absent Right—normal and passed suture from umbra to uterine cavity	Right tube normal throughout left cornua closed	Failure to excise the cornual portion of the right fallopian tube

tube which is freely movable, such as at its mid-point or even lateral to this region. The non-absorbable suture must be placed in the crushed area and be drawn tightly in order to avoid recanalization of the lumen at a later date, or the ligature's slipping off the loop immediately or at an early postoperative period. If ligated too vigorously or at an acute angle, the loop of tube may be cut through and again a fistula may result. Many modifications have been made in this original technique and failures have occurred with the modifications. Several operators have attempted to insure obliteration of the lumen in the loop of fallopian tube by doubly ligating it with a non-absorbable suture. This was done in 39 of our own 101 cases, and there was not a single failure in this group. Others have transfixed the ligating suture but this modification was not used in any of our cases.

No deaths followed tubal sterilization by the Madlener method in 101 patients. However, 7 deaths occurred in the total series of 470 sterilizations performed during the years which include the 101 Madlener sterilizations, making a total mortality incidence of 1.49 per cent, or 1.9 per cent of the 369 sterilized by methods other than the Madlener. One patient, in whom a pre-opera-

tive diagnosis of chronic nephritis had been made, died on the operating table at the close of the operative procedure. Death was attributed to shock in this patient who was far from an ideal operative risk. The other deaths occurred on the sixth (3 cases), seventh (2 cases), and ninth (1 case) postoperative days. The cause of death in these last 6 cases was attributed to peritonitis (3 cases), paralytic ileus (2 cases), and tuberculous pneumonia (1 case).

#### SUMMARY AND CONCLUSIONS

1 Five clinical failures of tubal sterilization by the Madlener method were encountered in a series of 101 patients, an incidence of 4.95 per cent.

2 The areas of attempted sterilization were recovered at the time of a second sterilizing operation, from both tubes of 4 of these patients, and from 1 tube of the other. Each area was serially sectioned to ascertain the reason for failure.

3 One patient had a very early pregnancy at the time of the Madlener sterilization. In 2 instances considerable regeneration of the tubal lumen occurred, so that the ligating suture must have been improperly tied or placed or slipped off the knuckle. This error was bilateral in 1 case. In a fourth patient the tubal lumina were appar-

entl completely obliterated but eventually an inferior lumen was re-established on one side by endosalpingiosis. In the fifth instance, both tubal lumina were replaced by scar tissue but a small tuboperitoneal fistula apparently developed as a result of endosalpingiosis on the medial side of the ligated knuckle of one tube.

4. The number of failures of tubal sterilization by this method should be reduced by more careful adherence to the technique as originally laid down by Madlener although certain modifications do not seem to have increased the incidence of failures.

5. There were no maternal deaths associated with the 51 Madlener sterilization operations but in 369 women sterilized by other methods during the same years, 7 deaths occurred.

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# CONGENITAL BILATERAL ABSENCE OF THE KIDNEYS

## A Critical Review with the Report of One Additional Case

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**C**ONGENITAL bilateral absence of the kidneys has been recorded 135 times since 1663. Proved bilateral agenesis, i.e., true non-formation rather than secondary atrophy, is even less frequent, for only recently has microscopic examination been done to ascertain the presence or absence of atrophied remnants of the metanephros. Even in the late reviews (1, 23) no stress was placed on the need for a careful search of the body cavities for misplaced atrophic renal tissue.

In the case reported here, special attention was paid to the distinction, poorly made in the past, between true agenesis and mere gross absence. Microscopic examination of closely spaced sections of the body wall, from diaphragm to membranous urethra, for remnants of metanephros (and mesonephros) supplemented the usual careful gross examination.

### CASE REPORT

The mother, a white multipara 40 years of age, had a normal pregnancy, except for the discharge of blood stained fluid 7 weeks after her last menstrual period. Her previous pregnancy resulted in a normal child at full term though there had been a premature rupture of the membranes. The family history was not relevant. Physical examination showed nothing pathological. Four months before the estimated date of confinement, the patient had some bloody discharge and uterine cramps. She was given supportive treatment but, in spite of this, a complete spontaneous miscarriage occurred.

Postmortem examination by Dr J F Rinehart showed a well formed white male fetus, 22.5 centimeters long from crown to coccyx, weighing 780 grams. The heart and great vessels appeared to be normally formed. The lungs were of the usual contour and lobed division. The thymus was normal. The abdominal viscera were in their usual positions. The liver was normal, the gastro intestinal tract was normally formed and rotation of the colon was complete. The anus was perforate. No kidneys or ureters could be found, and the bladder likewise apparently was absent. Further dissection was deferred pending fixation of the tissue. The external genitalia were normally formed. The testes were still within the abdomen. Routine microscopic examination of the organs showed nothing of note. Diagnosis: male fetus, approximately 4½ months' gestation, showing congenital absence of the kidneys, ureters, and bladder.

Subsequent examination of the abdomen and pelvis by the author verified the gross normality of the abdominal structures (Fig 1), careful additional search failed to

uncover the kidneys and ureters (Fig 2). The renal arteries were absent and no openings for them could be found in the lumen of the aorta. The adrenal bodies were absent also. The bladder, however, contrary to the findings of the preliminary examination, was present as a long narrow viscus with rugous lining extending into a normal obliterated urachus. The urethra was patent. The prostate appeared to be normal. Both hypogastric arteries were present.

Sections taken of all masses of adventitious tissue lying in the abdominal cavity proved them to be composed of lymphoid and areolar tissue. Sections then were made transversely every 3 millimeters down the posterolateral body wall and into the pelvis. The most cephalad of these, taken at the level of the first lumbar vertebra, showed no adrenal cortical tissue on either side (Fig 3). Lying about the renal fossae, however, were several large rounded structures made up of cells which looked like sympathetic ganglion elements. These were scattered about, as occurs phylogenetically when cortex and medulla normally fail to unite and represent the sympathetic (chromaffin) Anlagen of the medullary component of the suprarenals (Fig 4).

There was a small area on the left (Fig 5), between the psoas and the quadratus lumborum muscles, consisting of several large epithelial cell lined ducts, about which were grouped four or five rounded cell aggregates, with some evidence of association with small blood vessels. This structure was localized, for all sections taken lower down showed neither branching ducts and glomerulus like masses nor large duct formations. Grossly, no ureters could be found, and careful microscopic search proved their absence. Examination of the bladder showed no ureteral buds. The prostate was well formed and the urethra was complete, but the trigone (interureteral ridge and Bell's muscles) was absent. The testes, situated abdominally, were composed of the normal elements, with easily recognized epididymis, vas, and gubernaculum in each.

The sections aroused much speculation among those who saw them as to exactly what tissue was represented by the ductile remnants found between the psoas and quadratus muscles on the left. Their more cephalad position, their localization, and the complete lack of any parts of the ureters or ureteric buds weighed heavily in favor of their being mesonephric in origin (Fig 5). Opposed to this idea is the fact that normally the mesonephric structures atrophy and disappear at about 7 weeks. In this fetus with metanephric absence, it may reasonably be inferred that mesonephric development was abnormal as well. In view of the fact that no ureteral elements could be found and no parts of a trigone, we may accept this as a case of renal agenesis caused by a lack of one of the essential elements of normal metanephric development, the ureteral bud.



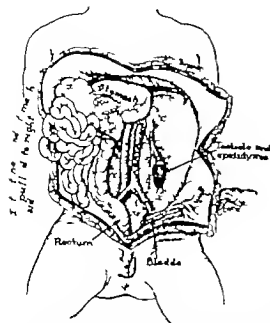


Fig. 1. Fetal view before evisceration, showing gross abnormality of lower limbs and genitalia. The aorta can be seen running on top of the psoas muscle next to which can be seen the left testis, epididymis and gubernaculum, on the mesentery.

#### REVIEW OF THE LITERATURE

In 1931 Rosenbaum combined the 32 cases previously reported by Coen with 59 additional ones from the literature and added one new case of his own bringing the total to 92. Madison found 6 cases noted in the literature between 1931 and 1934, and added 4. In 1937 Amolsch rechecked the literature and noted 12 cases not included in the tabulations of Coen, Rosenbaum, or Madison. He added 4 new cases. Amolsch omitted 1 case from Madison's total; a valid duplication and also left out one of Rosenbaum's cases (patient number 29, who lived 14 years) leaving the total at 106. A further search of the literature added 1 case reported by Kammerhuber in 1931; by Bates, 1933; by Vetter in 1936; 2 cases by Giordano in 1936; 1 case by Pellicano in 1936; 1 by Raso, 1937; and 3 cases by Soloway in 1939 as well as the 9 cases cited by Raso without details (Haxinger, Rubinstein, Blacklock, Edwards, Tsuchiyae, Kobayashi, Enta, Cooper, Gilbert, and Henkel). These, with the 106 cases bring the total to 135.

Though no one feature is common to all of these cases, certain generalizations can be made from them. Renal agenesis is usually associated with

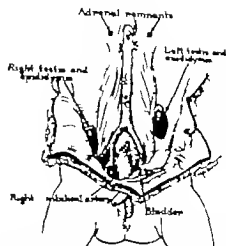


Fig. 2. Fetal view after evisceration. (A more detail.) The testis, epididymis, and large gubernaculum can be seen. The pharyngeal branches from the aorta are too prominent. The rectum protrudes from beneath the right umbilical artery. The right testis and epididymis are just visible. Sites of adrenal remnants indicated by arrows.

gross malformation of other organs. So seldom does the condition occur alone that Birnbaum was led to say that, complete absence of both kidneys, or the presence of an undeveloped rudiment, is very rare and occurs only in monsters incapable of living. These malformations focus about the lower extremities, for out of the total of 9 reviewed on this point, there were 30 recorded examples of sirenomelus, of apoa, and 8 of monopus, as well as 32 instances of fetores. (A less spectacular malformation of the lower limbs.) In addition there were 9 headless monsters all with abnormal lower extremities.

The adrenals unexpectedly were usually present and normal except for a change in their shape which was due to their new anatomical relationships.

The gonads were commonly present but abnormally formed. Most often the derivatives of the wolffian duct (in the male) and the muellerian duct (in the female) were affected. The bladder was absent in about half the cases. The external genitalia were usually rudimentary. In 1 case however (those of Amolsch, Bates, Goswami, Huerzler, Peschke, Madison, Mayer, Mueller, Rosenbaum, and Sarig cited by Raiser) only mesonephric and metanephric abnormalities were noted. The present case brings this group to 11 or about 8 per cent. These more normal instances are strong evidence that pressure is not the sole etiological factor.

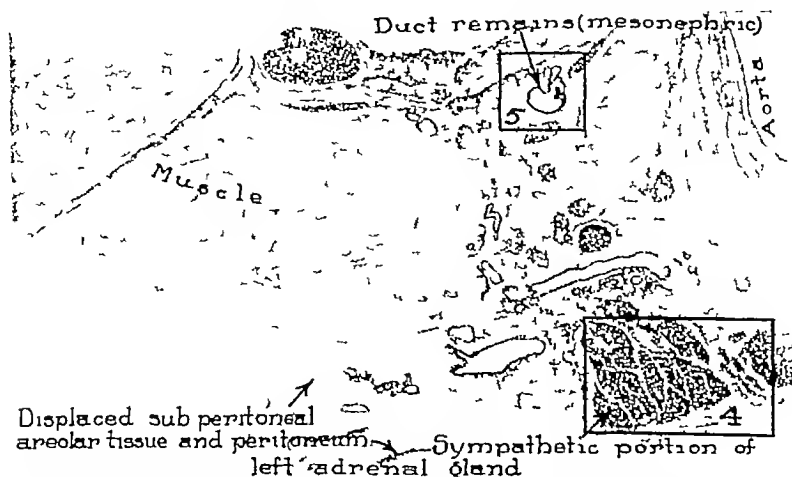


Fig 3 Diagrammatic drawing of histological section of the left lateral body wall showing areas from which photomicrographs (Figs 4 and 5) were taken

#### ETIOLOGY

Previous papers are almost unanimous in ascribing the absence of both kidneys to pressure exerted during embryonic development. While it is true that oligohydramnios, inflammation, and amniotic adhesions are often found associated with renal absence, it is scarcely logical to insist that a decreased amount of amniotic fluid *causes* the renal abnormality, the reverse could as well be true. Renal aplasia has occurred many times without abnormalities in the amniotic fluid. In the 11 cases here cited, mesonephric and metanephric defects were the only lesions. Certainly it is far-fetched to maintain that pressure, especially by so gross a means, could cause complete aplasia

of the kidneys without producing equally severe abnormalities in other organs from nearby anlagen. This argument is sharpened by the evidence in the present case, in which the testes and bladder (except for the trigone and ureteral orifices) were normal. The cortical components of the adrenal glands arise from the same mesodermal ridge as the glomerular portion of the kidneys, yet these glands are rarely malformed (note that cortical malformation has occurred in the present case).

Another hypothesis, with better evidence to support it, has been considered for many years, and recently has been strongly advocated by Madisson. He had 2 cases of bilateral renal

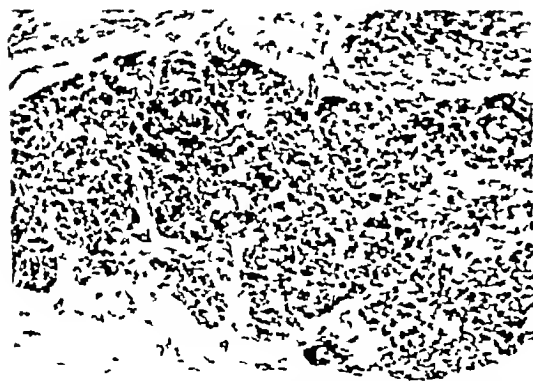


Fig 4 Photomicrograph of a portion of several fields of developing nerve (ganglionic) tissue some of which may have been intended for adrenal medulla



Fig 5 Photomicrograph of a duct like structure which is very strongly suggestive of a mesonephric remnant.



# HINMAN CONGENITAL BILATERAL ABSENCE OF KIDNEYS

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It is interesting to note that 11 days, the longest period that a baby with absence of both kidneys has lived, is approximately the interval that an adult is able to survive after bilateral nephrectomy

## SUMMARY

- 1 One new case of bilateral absence of the kidneys is reported
- 2 A review of the literature yielded 134 previous cases of renal agenesis, the majority associated with gross malformation of other organs
- 3 In this case the ureters, interureteral ridge, and vesical trigone also were absent and none of the cortical component of adrenal glands could be found although sympathetic ganglion elements were present There was no other gross malformation
- 4 The traditional etiological explanations are reviewed, with criticism of the hypothesis of pressure and emphasis on that of developmental arrest The rare possibility of an inherent defect in the germ plasma is admitted
- 5 Note is made that metanephric excretion occurs during fetal life, but is not vital to normal fetal development

Grateful acknowledgment is made to Dr C L Connor, professor of pathology, and Dr J F Rinehart, associate professor of pathology, for permission to report this case and for their encouragement, help, and generous loan of the facilities which permitted it

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# INVERSION OF THE UTERUS

## A Report of Five Personal Cases

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**I**NVERSION of the uterus is considered a rare lesion which may have a gynecologic or an obstetric origin. Pedunculated myomas or sarcomas are ordinarily responsible for the gynecologic inversions. The obstetric or puerperal inversions, which are the most common, are complications of the third stage of labor and form the basis of discussion in this paper. They may be incomplete when the uterine fundus does not extend farther than the cervix, and complete if any part of the corpus passes through the cervical ring. In extreme cases inversion of the vagina accompanies that of the uterus. Again, inversion of the uterus may be classified as acute, when the condition is seen early and the uterus can be replaced manually subacute, when the cervical ring has formed and reposition from below is impossible and chronic, when the lesion has existed for more than a month and involution of the uterus has taken place.

The incidence of inversion of the uterus varies in different clinics. Bland and Goldstein give an idea of it by the following figures taken from their article in Davis *Gynecology and Obstetrics* (1): Zangemeister 1 in 400,000 Von Braun, 1 in 350,000 Madden 1 in 100,800 Cache, 1 in 4,600 Aveling, 1 in 100,000 Hirst, 1 in 140,000 Beckman, 0 in 350,000 Wmckel, 0 in 20,000 Hacke, 1 in 10,000 Krassowsky 1 in 200,000 and Lenin grad, Lying In Hospital, 0 in 250,000.

These statistics and others quoted in the literature are those of excellent maternity centers. They do not, however, give a true picture of the condition as compared with statistics, were they available of patients who are delivered in their homes by men less skillful and less experienced in the art of obstetrics. It is a known fact, however that this disorder is becoming less frequent as the standard of practice is gradually raised.

Spontaneous uterine inversion may occur but preventively one of three factors, or a combination of them, is necessary in the development of this complication of childbirth. These factors are (1) undue relaxation of the uterine wall (2) pressure on the fundus from above and (3) traction on the

fundus from below. The Credé expression on a relaxed uterus or before placental separation, the erect posture in labor a short cord, straining of the abdominal muscles during labor coughing, sneezing, fundal implantation of the placenta, and the pressure of submucous myomas during pregnancy all play a rôle in the etiology.

Primipare are more disposed to this complication of labor than multipare, since, in the former the placenta is usually inserted nearer the fundus and also because of the greater rigidity of the uterine muscle during a first labor. If uterine inertia alone were the cause of inversion it would be found more commonly in multipare, in whom this disorder is more frequently encountered.

The mechanism of uterine inversion is well described by Jones as follows. After any portion of the uterus becomes indented to a considerable extent, the rest of the organ seizes this invaginated portion as it would grasp a foreign body and, in attempting to expel it, turns itself inside out."

The symptomatology varies in extent with the degree and the acuteness of the condition. Those patients in whom the inversion is acute suffer profound shock, hemorrhage, and pain, while those with chronic lesions complain of backache bearing down pain vesical and rectal tenesmus, anemia from continuous loss of blood, and signs of low grade infection.

The diagnosis is not difficult if one has this pathological entity in mind, yet, one of my patients had been under the daily observation of two physicians for a month and the diagnosis had not been made. Obviously the diagnosis is established largely by examination. In obstetric inversions inspection by means of speculum reveals a soft, pear-shaped tumor with the broad surface downward, filling the vagina. The uterine mucosa presents on the surface of the mass. This may be dark red or mahogany brown in the early stages and grayish in color in the advanced stages. On bimanual examination the fundus is missed in its normal position and there appears a crater shaped or cup-shaped depression in its stead. The rectal examination is of value in the location of this depression. The indentation produced by inversion is characteristic and is absent in other lesions considered in the differential diagnosis.

Before the days of aseptic surgery the mortality among patients with acute inversion was in the vicinity of 80 per cent. A review of the literature in 1925 led me to state that the mortality in acute inversion was approximately 34 per cent, and in chronic inversion about 6 per cent. At the present time the mortality rate in inversion of the uterus averages between 5 and 10 per cent. Death is ascribed to hemorrhage, shock, and sepsis. The attempt to reduce the uterus during the state of shock is an important contributing factor. Blood transfusions have rendered the greatest service in combating hemorrhage and shock. By the same token the patient is less exposed to sepsis because of her improved general condition. The mortality rate is still further reduced by the avoidance of any operative procedures or replacement until the patient is out of her shock and until she has been fortified against the ordeal which she is about to undergo. The treatment may be conservative or operative. The non-operative methods consist of manual reposition and pressure applied to the fundus from below by means of colpeurynters which are sometimes filled with mercury, the gauze pack, and elastic pressure.

The operative procedures may be carried out through the abdomen or through the vagina. For the patient in whom inversion is recognized moderately early, whose condition is classified as subacute, and in whom manual reposition cannot be carried out, the abdominal operation proposed by Huntington, in 1921, whereby the ring is dilated from above through an abdominal incision and successive portions of the uterus are picked up below the crater by a series of Allis forceps until the uterus is reinverted, has proved efficacious. The operation of Haultain, in which, after the abdomen is opened, an incision is made in the middle of the posterior portion of the constricting ring and the uterus is replaced by pressure through the vagina, should also receive consideration. The incision, which is about an inch (2.5 centimeters) or at most 2 inches (5 centimeters) in length, is found in the lower uterine segment, on its posterior surface, after the uterus is reposed. This incision is usually closed in 2 layers with catgut and the uterus is generally suspended by the round ligaments. This incision, placed in the lower segment, has an added advantage in that it interferes but little with future childbearing. The other abdominal operations consist of dilatation of the cervical ring from above and the reposition of the uterus from below, with or without preliminary incisions. Abdominal hysterectomy becomes necessary in the presence of serious pathological changes in the uterine musculature.

Because of its greater safety most surgeons choose the vaginal route in the treatment of chronic inversion. The choice rests between anterior colpohysterotomy (Spinelli operation) and posterior colpohysterotomy (Kuestner operation) when the uterus can be conserved, and vaginal hysterectomy when the opposite obtains. Vaginal hysterectomy finds its greatest field of usefulness in the treatment of gangrene of the uterine corpus. In America, at least, the Spinelli operation is the one which is most frequently chosen for the treatment of chronic inversion when the uterus can be retained.

Since 1924, during a period of 15 years, I have treated 5 women who suffered from puerperal inversion of the uterus. The conditions 2 of these patients presented were classified as acute inversions and 3 as chronic. Two of the patients were on my service and 3 of them were seen in consultation. In one patient who was seen immediately after the accident, the placenta was removed from the fundus of the inverted uterus and the organ was replaced manually without any special difficulty. Another, admitted with gangrene of the uterus after attempts at reposition had been made elsewhere, was treated by the Haultain method followed by abdominal hysterectomy, while the 3 others had Spinelli operations. All patients recovered. Brief abstracts of the case histories of these patients follow.

**CASE 1.** Mrs. M. D., 27 years of age, a secundigravida, was delivered at the Carney Hospital on June 27, 1924, by a staff member. Her first stillborn child, because of toxemia, was delivered at 8 months of pregnancy. Except for a moderate albuminuria there were no other complications during the present pregnancy. Her pelvis was ample. She was given 0.5 cubic centimeter of posterior pituitary extract at the full dilatation of the cervix and was delivered by low forceps of a normal female child, who weighed 8 pounds, 6 ounces (3,819 grams). The placenta, which was inserted at the fundus, was firmly adherent and in attempting the Credé maneuver the attendant inverted the uterus. The placenta was peeled from the fundus, the uterus was reinverted manually and was packed with sterile gauze. One cubic centimeter of an ergot preparation was administered intramuscularly. One hour after labor the uterus was flabby and signs of a slow and persistent hemorrhage were observed.

I saw the patient 4 hours after delivery, while making hospital rounds. She was then pulseless, was bleeding freely, showed signs of air hunger, and her condition looked desperate. Half an hour later she was given 1000 cubic centimeters of normal saline solution subcutaneously. Two and a half hours later she was given a blood transfusion of 600 cubic centimeters by the citrate method. Her condition rapidly improved and she was discharged from the hospital by her obstetrician on July 13, 1924, after an otherwise uneventful puerperium. A pelvic examination was not made at the time of discharge, so no note was made as to the condition of the uterus. One week after her discharge I saw her in her home in consultation with her physician who felt he had discovered a uterine prolapse. Because of

the lack of aseptic conditions, I preferred to do the internal examination in the hospital and advised that she come there at once. My advice was not taken, however, as she did not report until July 29, 1924, at which time examination revealed the typical findings of chronic inversion of the uterus. The uterine mucosa was grayish in color. A Spence operation was performed on July 30, 1924. The postoperative course was febrile, the temperature having risen to 103 degrees F. She was discharged on August 6, 1924, at which time the uterus was found in midpelvis, the anterior and posterior drainage tracts were healed and there was no pelvic tenderness. Her menstruation resumed in September, 1924, and became regular. On April 8, 1925, she was admitted to the medical service of the Carney Hospital, where diagnosis of chronic fibroid phthisis was made. On July 3, 1925 she was living in the country her tuberculous process arrested, she was gaining in weight, and was feeling well.

CASE 2. Mrs. N. F., 33 years of age, secundipara, as seen in consultation in private hospital in Boston on April 5, 1927. She had had children, but was living well, and no miscarriages. The first child was delivered with forceps, and the second with low forceps. The second child was born on February 6, 1927, and the attending physicians had not been impressed by any difficulties. At the third stage of labor, although the vagina had been packed several times for hemorrhage they had not recognized the inversion. The diagnosis was established on April 5, 1927, 78 days after delivery. On this day under general anesthesia, Spence operation was performed, and anterior and posterior drains were introduced. The patient was in good condition upon leaving the operating table. Two days later, April 27, 1927, she was given blood transfusion of 500 cubic centimeters by the citrate method. The convalescence was febrile, but the incisions healed satisfactorily. At the time of her discharge, 3 weeks after operation, the uterus was found in midpelvis, the drainage tracts and incisions were healed, there were no masses or areas of tenderness in the pelvis, and her condition was satisfactory.

CASE 3. Mrs. L. C., 30 years of age, tertiparous, as admitted to labor to the Carney Hospital on March 3, 1928. Her first pregnancy had terminated in miscarriage at 3 months of gestation and her second in normal delivery in March, 1927. The present pregnancy evolved without any complications, she had had adequate prenatal care, her labor lasted 12 hours, and there had been no lacerations. The well formed female child was delivered and cried spontaneously. During an attempt to deliver the infant the internal forceps of the labor completely inverted the uterus, with the placenta implanted at the fundus. I saw the patient very shortly after the accident. Under general anesthesia the placenta was peeled from the uterine fundus and the uterus was reinserted, starting with one corner, then the next and finally accomplishing the total reinsertion. The uterus contracted well and remained in satisfactory position. Since there was considerable shock, a transfusion of 500 cubic centimeters of normal saline solution was administered. The patient readily came out of shock and blood transfusion was not necessary. The puerperium was afebrile, and normal in all respects. Mother and baby were discharged in excellent condition on March 5, 1928. The involution of the uterus had progressed normally and there had been no undue loss of blood during the puerperium.

CASE 4. Mrs. L. M., 29 years of age, very obese tertipara, was admitted to the Carney Hospital on February 5, 1928. She had had previous labors the first terminated instrumentally in 1925 and the second normally in 1926. Considerable difficulty with the placental stage had been encountered in the last pregnancy. At 8:30 p.m. on

February 9, 1928, at the end of her third pregnancy she was delivered of healthy infant at the Marlboro Hospital. Although the delivery was normal, there was considerable difficulty with the third stage, which was followed by severe hemorrhage. On February 5, 1928, an inversion of the uterus was recognized, and an attempt was made to revert it. This was, however, without success. When I was called I advised that the patient be sent to the Carney Hospital, where she arrived at 3:30 p.m. She was then blanched, the uterus was as necrotic, gangrenous, and of foul odor escaped from the vagina. The vulva was ecchymotic and edematous, the perineum had been freshly lacerated as far as the sphincter and the vagina was purplish black in color. The hemoglobin was 35 per cent and the red cell count 2,40,000. A blood transfusion of 600 cubic centimeters was administered by the citrate method, her husband acting as donor. Since she had mild upper respiratory tract infection, spinal anesthesia was decided upon. This was difficult of administration because of her obesity and an extra long needle was used. The abdomen was prepared with ether and half strength tincture of iodine. The patient was placed in the Trendelenburg position and median suprapubic incision, which extended from the symphysis to the umbilicus, was made. The intestines were washed off from the pelvis with gauze. The bladder was found to have been pulled upward and to contain moderate amount of urine even though the patient had been catheterized before she was taken to the operating room. The bladder was again emptied by catheter. On examination, the crater of the inversion presented, and the tubes and ovaries were drawn into it. The ring was about 3 to 4 centimeters in circumference. The infundibulopelvic ligaments were ligated and cut. The cervical ring was incised posteriorly in the median line, and thus the vagina was opened, the posterior wall of the uterus was then incised sufficiently to pick up the sides with vulsellum and reinsert the organ (Hitzman operation). The uterus was then reinserted into the pelvis and another such bowl was spread over the pelvis. The round ligaments were ligated and cut. The bladder was next freely separated from the cervix and vagina, and the uterus and vaginal cervix were clamped, cut, and ligated. The uterus was then cut in such a way that the cervical incision met the posterior one already made; thus the gangrenous uterus and adnexa were removed. A yard of iodoform gauze was packed in the vagina, the end of which was left at the peritoneal cavity. The anterior and posterior leaves of peritoneum and the peritoneal edge of the bladder were approximated around the drain to cover over all raw areas. After change of gloves, the towel and sling of straps were removed from the pelvis, the sigmoid was led into it, the incisions were brought down to cover the incisions and the abdominal wall was closed in layers. The patient stood the operation well and there was practically no bleeding. A second transfusion of 500 cubic centimeters of blood by the citrate method was administered, after which she was returned to bed in excellent condition. At this time her brother-in-law was the donor. The convalescence was febrile. The highest temperature was 102 degrees F., pulse 90, and respirations 30 on the second postoperative day. The temperature, pulse, and respirations then gradually dropped to normal. She was discharged from the hospital on February 24, 1928, 9 days after admission, in good physical condition. On April 6, 1928, she was examined at the office. The abdominal incision was found to be well healed, without induration or tenderness. A vaginal examination showed deep laceration of the perineum but no cystocele or rectocele. A good sphincter was healed and well supported in the pelvis, no bulging on hard straining. Patient well and had resumed household duties.

## PHANEUF INVERSION OF UTERUS

CASE 5 Mrs M B, 30 years of age, a secundipara, was admitted to the Carney Hospital on May 25, 1938. She had had 2 children, both delivered with forceps, the last infant having been born 10 weeks before admission. For 7 days preceding admission there had been a constant brownish discharge and hemorrhages, the hemorrhages being especially severe when straining at stool. It was found on examination after admission that the vagina was filled with blood clot, the equivalent of 2 handfuls. After the evacuation of the clots a puerperal inversion was discovered. On inspection, the striking feature was the marked pallor, the hemoglobin was 45 per cent, the red cell count 2,770,000, and the white cell count 6,200. During the afternoon of May 26, she was given a blood transfusion of 500 cubic centimeters administered by the citrate method. On May 27, 1938, she was operated on, under spinal anesthesia. A typical Spinelli operation was performed. Drainage in the anterior and posterior cul-de sacs was instituted. A second blood transfusion was started as soon as she was returned to her bed. Again, the citrate method was used and 500 cubic centimeters of blood was given, a total of 1000 cubic centimeters being transfused. She stood the operation well. The convalescence was mildly febrile, the temperature was 102 degrees F, pulse 130, and respirations 34 on the first postoperative day, but all three were normal by the tenth day. She was discharged from the hospital on June 11, 1938, 17 days after admission, at which time her condition was entirely satisfactory. On July 18, 1938, she was examined at the office. The abdomen was soft, relaxed, tympanic, and there were no masses or areas of tenderness. The perineum was relaxed, the cervix, as healed, the uterus was normal in size, in second degree retroversion, and the adnæra were normal. The cervix, as seen through the speculum, showed good healing. The drainage areas, as well as the anterior vaginal incision, were healed. There was no cystocele or rectocele, the blood picture was normal, and the operative result was entirely satisfactory.

### SUMMARY AND CONCLUSIONS

- 1 Puerperal inversion of the uterus is a rare condition. With constantly improving practice it will become even less frequent.
- 2 The predisposing factors in the etiology are inertia of the uterus, pressure on the fundus from above, and traction on the cord from below.
- 3 Shock is the leading symptom, and when this occurs after the third stage of labor uterine inversion should be suspected.

4 In acute cases the uterus should be re-inverted manually when possible, as soon as the condition is discovered (Case 3). In cases in which this is not possible, laparotomy and reposition by taxis are the procedures of choice.

5 Chronic inversion of the uterus is well treated by the vaginal method, anterior colpohysterotomy (Spinelli operation) is performed when the uterus can be saved (Cases 1, 2, 5). Vaginal hysterectomy is the operation of choice when the opposite is true.

6 Abdominal hysterectomy may be resorted to when previous attempts at reduction have been made and the vagina is in such bruised, ecchymotic condition that it is impossible to recognize any landmarks to operate through it (Case 4).

7 Shock and hemorrhage should be combated by blood transfusion before any operative procedures are attempted. This precaution has considerably reduced the mortality during recent years.

8 The obstetric future of the woman who has had a Spinelli operation should be that of one delivered by means of a previous classical cesarean section.

9 Five personal cases of patients with puerperal inversion are reported, 1 was treated by manual reposition, 1 by an abdominal panhysterectomy with bilateral salpingo-oophorectomy, and 3 by the Spinelli operation. All patients recovered.

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the lack of aseptic conditions, I preferred to do the internal examination in the hospital and advised that she come there at once. My advice was not taken, however, as she did not report until July 29, 1924, at which time examination revealed the typical findings of chronic inversion of the uterus. The uterus mucosa was grayish in color. A Spinnelli operation was performed on July 30, 1924. The postoperative course was febrile, the temperature having risen to degrees F. She was discharged on August 6, 1924, at which time the uterus as found in midpelvis, the anterior and posterior drainage tracts were healed and there was no pelvic tenderness. Her menstruation was resumed in September, 1924, and became regular. On April 8, 1925, she was admitted to the medical service of the Carney Hospital, here diagnosis of chronic fibroid phthisis as made. On July 3, 1925, she as lying in the country her tuberculous process as arrived, she as gaining in weight, and as feeling well.

CASE 2. Mrs. N. F. 33 years of age, secondipara, as seen in consultation in private hospital in Boston on April 5, 1927. She had had children, but ere living and all, and no miscarriages. The first child as died ere it had reached the crown, and the second (it low forceps). The second child was born on February 6, 1927 and the attending physicians had not been impressed by any difficulties. At the third stage of labor. Although the signs had been packed several times for hemorrhage they had not recognized the in crisis. The diagnosis as established on April 5, 1927 78 days after delivery. On this day under general anesthesia, Spinnelli operation as performed, and anterior and posterior drainage are introduced. The patient as in good condition upon leaving the operating table. Ten days later April 27, 1927 she was given a blood transfusion of 500 cubic centimeters by the citrate method. The coagulability as feeble, but the incisions healed satisfactorily. At the time of her discharge, 3 weeks after operation, the uterus as found in midpelvis, the drainage tracts and incisions are healed, there are no masses or areas of tenderness in the pelvis, and her condition as satisfactory.

CASE 3. Mrs. L. C., 29 years of age, tertiaryipara, as admitted in labor to the Carney Hospital on March 3, 1928. Her first pregnancy had terminated in miscarriage 13 months of gestation and her second in normal delivery in March, 1927. The present pregnancy evolved without any complications she had had adequate prenatal care, her labor lasted 6 hours, and there had been no lacerations. The well formed female child as delivered and cried spontaneously. During an attempt at the Credé maneuver, the uterus in charge of the labor completely inverted the uterus, with the placenta implanted in the fundus. I saw the patient very shortly after the accident. Under general anesthesia the placenta as peeled from the uterine fundus and the uterus as reinverted, starting with one corner, then the next and finally accomplishing the total reversion. The uterus contracted well and remained in satisfactory position. Since there was considerable shock, subpectoral infusion of 700 cubic centimeters of normal saline solution as administered. The patient readily came out of shock and blood transfusion as not necessary. The puerperium as afebrile, and normal in all respects. Mother and baby ere discharged in excellent condition on March 5, 1928. The involution of the uterus had progressed normally and there had been no undue loss of blood during the puerperium.

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February 2, 1928, at the end of her third pregnancy she was delivered of healthy infant at the Marlboro Hospital. Although the delivery was normal, there as considerable difficulty in the third stage which as followed by severe hemorrhage. On February 5, 1928, as inversion of the uterus was recognized, and an attempt was made to return it. This was, however, without success. When I

as called I had heard that the patient be sent to the Carney Hospital, where she arrived at 330 p.m. She as then blanched, the uterus was necrotic, gangrenous, and very foul odor escaped from the vagina. The vulva as erythematous and edematous, the perineum had been badly lacerated as far as the sphincter and the signs was purplish black in color. The hemoglobin as 38 per cent and the red cell count 4,100,000. A blood transfusion of 600 cubic centimeters as administered by the citrate method, her husband acting as donor. Since she had mild upper respiratory tract infection, spinal anesthesia as decided upon. This was difficult of administration because of her obesity and an extra long needle as used. The abdomen as prepared with ether and half strength tincture of iodine. The patient as placed in the Trendelenburg position and median suprapubic incision, which extended from the symphysis to the umbilicus, was made. The intestines ere rolled off from the pelvis with gauze. The bladder as found to have been pulled upward and to contain moderate amount of urine even though the patient had been catheterized before she was taken to the operating room. The bladder as again emptied by catheter. On examination, the crater of the inversion presented, and the tubes and ovaries ere drawn into it. The rug as about 3 to 4 centimeters in circumference. The lateral uterine ligaments ere ligated and cut. The cervical ring as incised posteriorly in the median line, and thus the uterus as opened. The posterior wall of the uterus was then incised sufficiently to pick up the sides with sheaths and reinsert the organ (Hanshaw operation). The uterus as then wrapped in sterile towel and another such towel was spread over the pelvis. The round ligaments ere ligated and cut. The bladder as next freely separated from the cervix and uterus, and the uterine and vaginal vessels ere clamped, cut, and ligated. The vagina as then cut in such a way that the circular incision near the posterior one already made—then the gangrenous uterus and adnexa were removed a yard left of median line.

As packed in the vagina, the end of which as left in the peritoneal cavity. The anterior and posterior leaves of peritoneum and the peritoneal edge of the bladder were approximated around the drain to cover over all raw areas. After change of gloves, the towel and all other drapes were removed from the pelvis, the sigmoid was led into it, the omentum was brought down to cover the incision, and the abdominal wall as closed in layers. The patient stood the operation all and there as practically no bleeding. A second transfusion of 600 cubic centimeters of blood by the citrate method as administered, after which she as returned to bed in excellent condition. At these times her brother-in-law as the donor. The coagulability as feeble. The highest temperature as 100 degrees F. pulse 90, and respirations 30 on the second postoperative day. The temperature, pulse, and respirations then gradually dropped to normal. She was discharged from the hospital on February 24, 1928, 9 days after admission, in good physical condition. On April 6, 1928, she as examined at the office. The abdominal incision as found to be well healed, without induration or tenderness. Vaginal examination showed deep laceration of the perineum but no cystocele or rectocele. Vaginal vault as healed and well supported in the pelvis on bulging on hard pressure. Natural all and had resumed household duties.

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# EDITORIALS

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JULY 1940

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### RATIONAL TREATMENT OF URETERAL STONE

MODERN methods of treating stones in the ureter by manipulation constitute an important advance in urological practice. However they undoubtedly have limitations and when employed injudiciously are not devoid of danger. Stimulated by Crowell's report in 1931 of the removal of 88 stones in a series of 95 cases by cystoscopic procedures, many urologists have developed instruments and methods for the non-operative removal of ureteral calculi and this has led some to develop excessive enthusiasm for these methods.

It is a well recognized fact that many stones will pass unaided if permitted to do so and that others will require removal by operative means, despite attempts by manipulation to facilitate their passage. The wise choice of the most suitable method of treatment is of the utmost importance to the patient with an obstructing ureteral calculus, and may not

only save him from serious renal damage but also from much suffering.

Such factors as the size and shape of the stone, its position in the ureter and its mobility must be considered. Very small stones will usually pass spontaneously or after a simple manipulation, while very large stones undoubtedly will require removal by ureterolithotomy. However the position of a particular stone together with evidence as to whether it is fixed in one position or is progressing down the ureter is of greater importance than the actual size of the stone in most instances. Stones are usually arrested at the natural points of narrowing of the ureter: the ureteropelvic junction, the brim of the pelvis and at its entrance into the bladder. Their arrest at other points may be considered as evidence of stricture or other obstruction to their passage. Further stones located in the lower portion of the ureter are more amenable to removal by manipulation than those located above the brim of the pelvis. Operative removal in the pelvic portion is often exceedingly difficult while ureterolithotomy in the upper two-thirds of the ureter is usually a simple operation attended with little or no risk. Therefore more persistent attempts at non-operative removal are justified in the portion of the ureter immediately above the bladder.

In addition to these problems, it is necessary to consider the risks of each procedure. Removal of a stone by manipulation is often termed conservative and by ureterolithotomy as radical treatment. Are these cystoscopic manipulations conservative in all instances? If those stones which would pass spontaneously are excluded probably 60 to 80

percent may be assisted in passing by manipulation and the remainder will require surgical removal. The problem of when to attempt the removal of a stone by manipulation and how long to persist in the use of this method together with the choice of instruments and procedures undoubtedly require much experience and good judgment.

Trauma to the ureter due to a poor choice of instrument or lack of gentleness, has led to serious complications even requiring the ultimate loss of a kidney by nephrectomy. Bumpus has pointed out that no instrument should be employed for the extraction of a stone which cannot be withdrawn from the ureter without difficulty after it has engaged the stone. This is an excellent rule to follow. Instruments of the spiral or cork-screw type can always be reversed so as to disengage a stone which is too large to be pulled down the ureter with safety. Many experienced urologists have ceased to employ except rarely any of the mechanical stone extractors and rely upon adequate dilatation of the ureter by tapered ureteral bougies and by the passage of multiple ureteral catheters which may be allowed to remain in the ureter for twenty-four hours. Fever, pain in the loins and other evidence of renal infection, whether occurring independent of manipulation or following such procedures, usually indicate that immediate surgical removal of the stone is imperative. Failure to relieve promptly the obstruction with the resulting back pressure and inflammatory process will lead to irreparable damage to the kidney.

Each surgeon should endeavor to assess all the clinical factors applicable to each patient, together with the factor of his own personal training and experience, and thus choose wisely the method most suited to the particular patient. By so doing, he will assist in the passage of the stone in many instances by

cystoscopic manipulation, and in others in which these methods are unsuitable will by early operation save many patients from long periods of suffering, anxiety and prolonged invalidism and from irreparable renal damage.

GORDON S. LOURIE

## TOTAL GASTRECTOMY IN GASTRIC CANCER

CANCER of the stomach according to Livingston and Pack, has killed nearly one third more individuals in fifteen years than the trachea fatalities in this country over a similar period of time. All the years of the United States have totalled only fifteen years, but fifteen years of gastric cancer deaths have totalled about two and a half times as many as all our war fatalities.

At present surgery offers the only means by which cancer of the stomach can be treated successfully. Unfortunately, however, the disease is already so far advanced in most patients that come to the surgeon that only from one fifth to one fourth of the tumors can be resected with any hope of eradicating all grossly involved tissue. Obviously it would improve the situation to educate the public to consult a physician promptly when dyspepsia develops, to educate physicians to provide competent roentgenological examination of such patients without delay and to suspect cancer in any gastric ulceration that does not heal quickly when treated vigorously. Such education, however, appears to be slow and discouraging and in the meantime the surgeon is faced by the reality of making the best of a bad bargain.

While the results of operation for gastric cancer by the average surgeon are quite disheartening, both as regards operative mortality and later survival rate, Livingston and Pack have shown that the better qualified sur-

geons in this country and abroad have attained notable success in the resectable group of gastric cancers. Fifty per cent five year definitive cures for patients with gastric carcinoma without invasion of lymph nodes at the time of gastrectomy 55 per cent ten year cures for patients having removal of grade I and grade II cancers, and 20 per cent ten year cures for unselected types of resectable gastric cancer treated by excision (which signify respectively a 60 per cent, 80 per cent and 30 per cent approach to the maximum attainable survival rate for the age group treated) constitute a degree of success which exceeds that attained in the care of any form of strictly internal cancer and approximates or equals that obtained in the management of many external or readily accessible varieties of malignant tumors. It must be emphasized however that these figures represent the results obtained not by the average surgeon but by a comparatively small group of surgeons working under the best conditions. The facts indicate clearly the desirability of placing the patient with cancer of the stomach in the care of specially trained surgeons and properly equipped institutions. There would be thereby an immediate decrease in operative mortality and a marked increase in the later survival rate. Any further advance must then come through improvement in resection itself.

Improvement in the results of the surgery of cancer has always followed increasingly radical operation. The more widespread the removal of a tumor and adjacent tissues in which it may spread the greater the chance for prevention of recurrence through tumor cells that are present though not grossly evident in the tissues beyond the line of resection. In the stomach the blood and lymph channels form such a complex network that each part of the organ has vascular and lymphatic connection with every other part.

Study of tissues removed at operation and necropsy often reveals the presence of tumor cells microscopically evident far beyond the limits of the grossly demonstrable tumor. Furthermore, the patients that die of a recurrent cancer following partial gastrectomy frequently develop the recurrence in the stump of the stomach.

Carried to its ultimate conclusion the ideal procedure for the surgical treatment of cancer of the stomach should be total gastrectomy including as much duodenum and as much of the adjacent lymph bearing tissue as possible in all instances in which such a procedure is technically feasible and pathologically effective in removing all grossly involved tissue.

Total gastrectomy has been done often enough and by a sufficient number of well qualified surgeons to establish a feasible and reasonably safe and standardized technique for its consummation. Roeder in 1933 reviewed a total of 88 instances of the operation and Allen in 1937 reported a series of 15 and commented upon the fact that "the operation has become quite commonplace. The tendency of some individuals to develop anemia after total gastrectomy seems to be satisfactorily controllable by diet and other forms of treatment. There seems to be no obvious reason why one should not live indefinitely without a stomach. While the operative mortality of total gastrectomy is now relatively high, this fact must be somewhat discounted by the circumstance that at present total gastrectomy is performed as practically a last resort in only those patients with extensive local disease and marked secondary systemic effects. Likewise the prognosis and morbidity have been based upon the same group of patients those in whom the outlook was hopeless by any other treatment than total gastrectomy and not much more hopeful after it had been done.

It would seem that total gastrectomy should be worthy of a trial by properly qualified surgeons in the earlier, less extensively involved cases of gastric cancer rather than being reserved for only those patients with very extensive or total involvement of the stomach. The operation would appear to be especially indicated in the younger group of individuals with tumors in the higher grades of malignancy. The operative mortality should be minimal in this group and the prolongation of life maximal in those that survive the operation with complete eradication of the tumor.

Even at best, of course, because of inherent technical difficulties the field for total gastrectomy must remain more or less restricted. And until more frequent use and greater experience still further standardize the technique the operative mortality will remain higher than that of partial gastrectomy. There would seem to be good reason to believe, however, that in the hands of properly qualified surgeons, improved morbidity after total gastrectomy should more than counterbalance the immediate mortality of the operation.

CHARLES BRUCE MORTON

# TEXTS AND DOCUMENTS

ARNO B. LUCKHARDT M.D. Chicago, Illinois

**D**R. PHILIP SYNG PHYSICK (1768-1837) was a native of Philadelphia where he also practiced surgery for some forty-six years. He practiced general surgery which at that time meant every field from lithotomy to lens extraction. Because of native mechanical ingenuity he devoted himself by choice to what would now be spoken of as the orthopedics.

His literary contributions of medical or surgical nature are not numerous. Had they been he would have definitely assured himself priority for several surgical innovations and successes. What his bibliography lacks in literary poundage it makes up with all its brevity in classical contributions of lasting scientific merit. Because some of the latter are buried in journals which have suspended publication long time ago, it seemed appropriate to reprint two of them at this time in order to save from oblivion the physician who has been given the epithet of "The Father of American Surgery." Both contributions can not fail to interest every medical man but undoubtedly the second one on absorbable sutures will be of particular interest to surgeons.

From the Department of Physiology, University of Chicago

Reproduction of an engraving by R. W. Bishop from the original portrait by M. Breen owned by the Medical Club of the University of Pennsylvania.

There being no intention to write a biographical sketch of Dr. Physick, brilliant pupil of John Hunter and friend of Benjamin Rush, a few bibliographical references to such biographies or biographical sketches will be appended where the particularly interested reader can find account of his life together with his other remarkable contributions to medical practice.<sup>1</sup>

The reproduction of the first original paper might well be prefaced by this statement:

In spite of the attempt by its author to attribute to Dr. Alexander Monroe tertius, as act of justice the discovery and use of stomach tube for purposes of sucking out the stomach in cases of poisoning from ingested drugs or of administration by this means of antidotal drugs, medical posterity

has by universal consent given Dr. Physick full credit for the discovery of this important therapeutic measure.

For completeness sake both the memoir and the subsequent open letter on this subject now follow.

A Memoir on the life and character of Philip Syng Physick, M.D. by J. Randall, M.D. Philadelphia, Printed by T. K. and P. G. Collins, 1870, p. 14. Necrological notice of Dr. Philip Syng Physick by W. E. Horner, M.D., Philadelphia, Barrington & Hazard, 1837, p. Philip Syng Physick, *Journal of Orthopedic Surgery*, 1771 & 1772, not known. Philip Syng Physick by Mortimer J. Cook, *Intimate Medical Journal* of XVII, No. 4, 1910, pp.



PHILIP SYNG PHYSICK, M.D.  
1768-1837<sup>2</sup>

# ACCOUNT OF A NEW MODE OF EXTRACTING POISONOUS SUBSTANCES FROM THE STOMACH<sup>1</sup>

By PHILIP S. PHYSICK, M.D., Professor of Surgery in the University of Pennsylvania,  
Surgeon of the Pennsylvania Hospital as of 1794

ON Thursday 6th June 1812, I was sent for in much haste at nine o'clock in the evening to visit two children of Mr S. B. each three months old. They were twins, and had been affected with whooping cough for several weeks. The mother informed me that in consequence of her children having been very restless the night before, she hid this evening given them some laudanum. To William she had given one drop at seven o'clock, and the same dose to Edmund forty minutes afterwards.

I found William in a state of stupor or very profound sleep, from which he could not be roused, and was informed, that just before my arrival, his whole body had been strongly convulsed, his breathing was laborious and his pulse feeble and slow. On inquiry, I found that the vial out of which the drop of laudanum had been given, had contained, several weeks before, nearly one ounce of that medicine, but having been left without a cork, it had dried away so much that one drop only could be obtained for William, in order to procure another drop, two drops of water had been put into the vial and stirred about, by which another drop had been obtained and given to Edmund, forty minutes having intervened between the two doses.

About a quarter of an hour before my visit, the mother had given to William fifteen drops of antimonial wine, but as it had produced no effect I prescribed an emetic of ipecacuanha, and directed it to be given immediately, this however was found impracticable, as the child was incapable of swallowing.

At half past nine o'clock, Edmund, who had appeared to be in a very easy sleep, became convulsed, and his pulse and breathing were affected in the same way that his brother's had been. We attempted to give him ipecacuanha, but could not make him swallow it. The countenances of the children became livid,—their breathing very

laborious, with long intervals between the times of each inspiration, and the pulse in each very feeble.

Under these circumstances it clearly appeared no time was to be lost, and therefore, as they could not swallow anything, I determined to inject an emetic into their stomachs. For this purpose a large flexible catheter was passed through the mouth down the oesophagus into the stomach, and through this, one drachm of ipecacuanha mixed with water was quickly injected by means of a common pewter syringe. In hopes that the emetic would operate, I waited some time without any effect being produced. William exhibited now every symptom of speedy dissolution,—his face became very livid,—the pulse and respiration had almost ceased, and indeed the pulse could not be perceived, except a faint stroke or two, after that kind of imperfect and convulsive inspiration which is commonly observed in children just before actual death, accompanied with a convulsed action of the muscles of the mouth and neck. In this situation I passed the catheter again, and by applying the syringe to its projecting end, drew up the fluid contents of the stomach, and immediately injected warm water which was again withdrawn<sup>2</sup>. These operations were alternated two or three times, but when completed no sign of life remained. Hopeless as the case now appeared, I injected some spirit<sup>3</sup> and water mixed with a little vinegar through the catheter,—in less than one minute the child again inspired, the pulse became perceptible at the wrist, and in four minutes, with the aid of external stimuli, both went on so per-

<sup>1</sup>The idea of washing out the stomach with a syringe and tube in cases where large quantities of laudanum or other poisons had been swallowed occurred to me at least twelve years ago and I have constantly for many years recommended it in my lectures. In the year 1800 Dr Dorsey performed the operation of washing out the stomach in such a case but the patient had taken the poison twelve hours before he was called so that he did not succeed. Since writing the above I have been informed that in an European journal a French surgeon has lately proposed injecting the stomach. My informant has unfortunately mislaid the pamphlet.

<sup>2</sup>See Medical Repository volume 5 page 347

<sup>3</sup>The Eclectic Repertory & Analytical Review vol III Philadelphia Published by Thomas Dobson 1813 pp 111-114



fectly that there was every reason to believe the child would recover.<sup>1</sup>

By the time that these operations were performed on William Edmund was observed to have passed into the same condition of apparent death, from which his brother had just recovered. The same measures were adopted in his case and with the same happy effect. I now flattered myself that the children would do well, but in this expectation I was disappointed. In about half an hour Edmund's breathing became very slow and laborious and his pulse which had before been very much excited became so feeble, that he appeared to be sinking very fast. Supposing that the effects observed might be produced by the spirit which had been given occasionally in intoxication, I determined to extract it from the stomach and to inject warm water removing it again. This operation was very quickly performed, but at the conclusion of it I was much distressed by seeing the little patient to all appearance lifeless. Observing in this case that the actions of life ceased so immediately after the extraction of the spirit, I determined to try it again, and injected a little weak brandy and water. In less than a minute this occasioned a repetition of breathing and of the action of the heart, and in about five minutes both were regularly performed. The symptoms of ebriety took place also in William, but observing that his brother had been nearly lost by extracting the spirit from his stomach, I did not attempt the removal of it in William's case.

Doctor Austin who kindly assisted me on this occasion, remained all night with my little patients. He informed me that after some time they became better though they both had slight convulsive motions occasionally through the night. Their bowels were moved several times by castor oil. After five o'clock in the morning Edmund had no convulsions, but they continued with William until twenty-five minutes after nine when he struggled a little, sighed, and expired. Edmund was troubled for two or three

It might be suspected, that the catheter passing through the lumen, would endanger inflammation from its insertion over the top of the bladder, but this was not the case, because the children commenced breathing before the instrument was removed. I found also with my finger that the instrument pushed on one side or other of the urethra, so that it could not obstruct the passage.

days with a diarrhoea, but soon recovered completely.

## To the Editors of the Eclectic Repertory

(A Open Letter)

Gentlemen,

When I sent you the communication published in the first number of the third volume of the *Eclectic Repertory* descriptive of what I supposed a new method of extracting poisons from the stomach, I was influenced by desire to propose to my medical brethren a method of treatment which might preserve the lives of many unhappy persons, be either by design or accident had swallowed large doses of laudanum or other poisonous substances. If in a single instance I had been instrumental in preventing death, I should have considered myself very happy and to have withheld communication which might have been attended with such beneficial effects, would have been in every respect unjustifiable.

I have the pleasure of announcing to you and to your readers, that in several instances which have recently occurred in this city the practice has been completely successful.—In two cases treated by Dr. Doxey in which large quantities of laudanum had been taken there is great reason to believe that no other mode of treatment would have succeeded in preventing the fatal event. Both patients were saved by injecting warm water into their stomachs, and extracting it again, together with the laudanum, by means of syringes.

I therefore am happy in having called the attention of the profession to a mode of treatment not before used in this country. I trust within my knowledge but I have now an act of justice to perform in ascribing the merit of the invention to Dr. Alexander Moore Junior of Edinburgh, who published it in his inaugural thesis, in A.D. 1807. Of this circumstance I was entirely ignorant when I sent you my paper and probably should still have remained so had it not been mentioned in his book of *Morbid Anatomy* work which has but very lately come to my hands.

Very respectfully I am,  
gentlemen, yours &c.  
PHILIP STROG PRAXIS,

Philadelphia, 20th January 1833  
(for c) p 350-38

# MEDICAL AND PHILOSOPHICAL INTELLIGENCE FOR THE *ECLECTIC REPERTORY*

The importance of the second brief contribution requires no introduction except perhaps the remark that Dr Physick has been unintentionally neglected in a recently published beautifully executed series of historic and pictorial dramatizations on surgical suture material over the centuries

The Editors [*Eclectic Repertory* vol 6 1816 pp 389-390] are pleased to have it in their power to lay before their readers the following interesting Communication from Dr Physick which has just been handed to them Had it been sooner received it would have occupied a more appropriate place in this Number

HAVING repeatedly experienced considerable delay in the healing of wounds from ligatures applied on divided arteries remaining a long time in the sore before they could be removed, I have for many years been very desirous of avoiding such an inconvenience in the use of ligatures With this view, the first idea that occurred was that of drawing the ligature tight on the vessel by the assistance of a double canula unfortunately, the first patient on whom it was employed for securing the femoral artery, died of tetanus, and though I by no means believe the disease to have been occasioned by the instrument, yet the event discouraged from further trials of it

Several years ago, recollecting how completely leather straps, spread with adhesive plaster, and applied over wounds for the purpose of keeping their sides in contact, were dissolved by the fluids discharged from the wound, it appeared to me that ligatures might be made of leather, or of some other animal substance, with which the sides of a blood-vessel could be compressed for a sufficient time to prevent hemorrhage, that such ligatures would be dissolved after a few days and would be evacuated with the discharge from the cavity of the wound

Under this impression, I requested Dr Dorsey to try the experiment on a horse, by using

a ligature of buckskin This was found to answer every purpose, and came away in a few days

This fact was mentioned at the time to several of my medical acquaintance, and I understand that Dr Hartshorne has lately tied up some of the arteries after amputating the thigh, with ligatures of parchment They were found dissolved at the first dressing Dr Dorsey, in several operations, in which I have assisted, has used ligatures of French kid, which he finds stronger than any other leather He has it cut into narrow strips, stretches them and peels off the coloured polished surface No hemorrhage has taken place in any instance, and the ligatures are found dissolved at the end of two or three days

With the view of ascertaining what animal substance would withstand the solvent power of pus for the longest time, I suggested the plan of trying different articles, by applying them over the surfaces of ulcers Buckskin, kid, parchment, and catgut, have been tried in this way The buckskin and kid dissolved first, then the parchment, when at the same time the catgut was but little changed From an apprehension that in tying large blood-vessels the leather might dissolve too soon, I have requested Dr Dorsey, to try leather impregnated with varnish used by Mr Bishop of this city, in making elastic catheters, in the hope that when so prepared it will be somewhat more durable Perhaps tendon would be found to answer the purpose Future experiments will probably place it at the command of the surgeon a variety of these ligatures, which may be so selected as to remain the exact length of time he may require

This hasty notice on the subject is given, because it is thought important that these facts should be made public without delay

P S PHYSICK

Philadelphia, July 2, 1816

<sup>1</sup> Dr Physick's nephew

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

**O**CCASIONALLY there suddenly appears a book for which there is an obvious need, one which has an immediate practical definite group of readers, and one which will cause the reader to wonder why such a book has not made an appearance earlier. Just such a book is Hamby's 718 page pocket size compendium of suggestions for the care of neurosurgical patients.

All too frequently nurses have no special appreciation for the care needed by pre-operative or post-operative neurosurgical patients and the same can be said for internes and residents on the house surgical staffs of hospitals. Such patients must have type of nursing care medication, dressings, and other attention which cannot be carried over from the technique of an eye nose and throat genitourinary or fracture service. Since the successful outcome of many neurosurgical cases is directly dependent upon intelligent hospital care the author has written in concise uncomplicated interesting, and practical form a set of instructions to nurses and house officers which is sane, common sense and which is applicable to all neurosurgical patients regardless of the special technique of various clinics. It is a book that certainly should be on the shelves of every hospital nurses library and on the desk of every interne under whose care neurosurgical patients come. Incidentally many of the suggestions written for the care of this class of patients could well be adopted for the care of patients in general surgery whose care, in some hospitals, is often inadequate, a tiquated, and irrational.

It is to be doubted whether the brief anatomical introduction to the various chapters is of much value, inasmuch as they are quite brief and most internes

will have to hand more adequate anatomical references. The simple line drawings are effective. Above all, the author has stuck to his original objective and the result is a happy and useful one.

JOSEF MARTIN.

**D**R. BARNES of the cardiac section of the Mayo Clinic presents in his book *Electrocardiographic Patterns* his studies of localization of myocardial infarcts by the electrocardiographic method, and ventricular strain, which he has formerly shown in exhibits. The book also contains electrocardiographic material with regard to pericarditis, certain

drugs, metabolic disorders, as well as a chapter on Lead IV.

The author presents his studies regarding localization of cardiac infarcts in a very satisfactory manner. The drawings set a high standard of perfection which the electrocardiograms do not quite attain. Although most observers are quite in accord with Dr. Barnes's viewpoint, dissenting opinions are afforded scant mention.

With regard to electrocardiographic changes of right and left ventricular strains there are excellent drawings and typical electrocardiograms. There is considerable question as to whether he proves his point with regard to the diagnostic inferences which can be made from the electrocardiogram to localize heart strain. The shorter bibliographies of these chapters suggest that his ideas have not been completely verified.

Dr. Barnes's presentation of these subjects in book form will be interesting material to many readers.

CHARLES C. THOMAS.

**I**T might seem strange to see a book entitled *Medicine of the Ear* but the practice of otology is changing so rapidly that one no longer looks upon the specialty as purely surgical. Many new phases of treatment and diagnosis have appeared in recent years which are purely fundamental medicine. The general theme of this book is the present diseases of the ear under anatomy physiology diagnosis and non-surgical treatment and to correlate them with operative procedures. Recent contributions to otology have come from the researches of physiologists and bio-chemists, physiologists, and pharmacologists, and no present day textbook contains all the latest investigative work. The action of drugs on the vestibular and cochlear mechanisms, and the use of sulfonamide in otology are some of the more recent important studies. It is with this thought in mind that a loose leaf system of medicine of the ear was created. It is a companion volume to *Surgery of the Ear* and possesses many of the same advantages. It is monographic in style written with authority and knowledge of the subject. It can be kept up to date by addition of new material, and it is presented in a readable and easily understandable style.

A special chapter is devoted to the pathology of the labyrinthine capsule because of the fact that otosclerosis is located in the bony shell. For a time

THE HEMORRHOID CASE OR HEMORRHOIDAL PILES. By WALTER B. HAMBY, M.D. F.A.C. Springfield, Ill. and Baltimore, Md. Charles C. Thomas, 1930.  
ELECTROCARDIOGRAPHIC PATTERNS. BY DR. BARNES, AND CLINICAL SIGNIFICANCE. By ARTHUR R. BARNES, M.D. Springfield, Ill. and Baltimore, Md. Charles C. Thomas, 1930.

WILLIAM LOOSE LEAF MEDICINE OF THE EAR. Edited by Edmund Francis Fowler, Jr. M.D. New York. Foreword by John Demarest Kerman, M.D. New York and Edinburgh: Thomas Nelson, 1930, 1931.

histological specimens were rare but due to enthusiastic investigation in various countries, the otic capsule has become one of the best and most carefully examined parts in osteology. Nager has gathered together various specimens of osteoporosis, otosclerosis, osteitis and osteomyelitis and presented them in clear and legible plates, easy to read and easy to understand. The same clear cut expression of the subject is carried out throughout the various chapters dealing with the physiology of the vestibular apparatus, diseases of the middle ear, and diseases of the neural mechanism of hearing. In addition there are chapters on congenital malformations of the ear, inflammation of the external ear and the external auditory canal, the eustachian tube and adjacent nasopharynx, deafness from drugs and poisons, traumatic deafness, tests for hearing, diseases of the vestibular mechanism, management of the deaf and hard of hearing, and the deaf-blind.

The book approximates 600 pages with innumerable cuts and plates, all on good quality paper with clear legible type. There is an excellent bibliography at the end of each chapter. No doubt the volume will find ready use as a consultant on diseases of the ear.

JOHN F. DELPH

NOW in its third edition Dr. Bland's *Gynecology*<sup>1</sup> is a very excellent book on the subject. New chapters have been added on female hormonology and the ovarian endocrine tumors are described and pictured. There are no special chapters on gynecological operations, but each is described in relation to a disease or abnormality as it comes in the text. This is a logical method. Endometriosis is considered separately and a very clear discussion of this interesting lesion is presented. Not all will agree with the belief expressed in a bleeding factor as a cause of abnormal uterine bleeding, or with the term "interval endometrium." The use of radium to check bleeding of an unexplained type in women after the menopause should not be advocated.

This book can be read with great interest and should be of value to surgeons, gynecologists, and general practitioners. Very few statements in it can be challenged. Dr. Bland's book is highly recommended.

JOE VINCENT MEIGS

THE book entitled *Roentgen Technique*<sup>2</sup> by Clyde McNeill deals principally with roentgen anatomy and positioning. Because of the constant changes in the field, very little space is devoted to apparatus or exposure technique. The material is so arranged that on the left hand page one finds a certain position photographically illustrated as well as a line drawing or a reproduction of the resulting roentgenogram while on the right hand page there appears a concise description of the procedure. References have been added for those who wish to do further reading.

<sup>1</sup>GYNECOLOGY MEDICAL AND SURGICAL. By P. Brooke Bland, M.D. F.A.C.S. Assisted by Arthur First, M.D. 3d rev. ed. Philadelphia: F. A. Davis Co. 1939.

<sup>2</sup>ROENTGEN TECHNIQUE. By Clyde McNeill, M.D. Springfield, Ill.: Baltimore, Md.: Charles C. Thomas, 1939.

The addition of charts and drawings on bone development and accessory bones enhances the value of the volume.

Over 100 standard positions are described with reference to simple apparatus available in the average laboratory rather than to the more elaborate and expensive equipment. Roentgenologists, teachers of roentgen technique, and x-ray technicians should find this concisely arranged and practical volume useful in their work.

EARL E. BARTH

THE third edition of *Manipulative Surgery*<sup>3</sup> has been thoroughly revised and extensively rewritten with the addition of new chapters upon "The Cult of Osteopathy" and "The Prevention of Adhesions," and a number of new illustrations.

The author stresses the fact that manipulation is a highly specialized subject. He approaches the subject from his viewpoint as an orthopedic surgeon, and indicates the conditions in which open operation or other measures would yield more satisfactory results than manipulation.

There is also an excellent chapter on the dangers of manipulation in unsuitable cases. However, the author points out that there is a tendency among some to emphasize unduly the dangers of manipulation. This monograph gives an excellent presentation of the great importance and value of manipulation in the treatment in carefully selected cases of certain sequelæ of injuries and diseases, particularly affecting the joints, muscles, tendons, and fascia. It is pointed out that the margin between success and failure in manipulation is often a narrow one, and may depend upon some point of detail, not only in the technique itself but in the after treatment, or even in the psychological approach to the patient.

This monograph can be recommended as giving an excellent and conservative discussion of the controversial subject of treatment by manipulation.

JOHN S. COULTER

IN the preface to the third edition of *Practical Obstetrics*<sup>4</sup> Bland and Montgomery state that "considerable revision and rewriting" has been done, toxemias of pregnancy, endocrine physiology, obstetrical anesthesia, and treatment of the newborn are the chapters mentioned in this regard.

The 500 illustrations are well selected. Most of them are in black and white, although color has been used for emphasis in a certain number of them.

As in most textbooks the authors' personal views concerning the subject of toxemias are set forth, and the toxemias are classified accordingly, for instance, considerable space is devoted to a differential diagnosis of "simple vomiting" and "pernicious vomiting." The next subject considered is acute yellow atrophy of the liver, then nephritic toxemia, low reserve kidney, giving Standers' clinical criteria for

<sup>3</sup>TREATMENT BY MANIPULATION. By A. G. Timbrell Fisher, M.C. M.B. Ch.B., F.R.C.S. (Eng.). Being the 3d ed. of *Manipulative Surgery*. New York: Paul B. Hoeber Inc. 1939.

<sup>4</sup>PRACTICAL OBSTETRICS. By P. Brooke Bland, M.D. and Thaddeus L. Montgomery, M.D. 3d rev. ed. Philadelphia: F. A. Davis Co. 1939.

this condition, pre-eclampsia and eclampsia re then considered in order.

Under the subject of ablatio placente the authors describe Irving's management of the condition, but add that cesarean section with extirpation of the uterus has its place in the treatment of this condition.

The authors' depreciation of Braxton Hicks version is difficult to understand. Certain environmental and obstetrical conditions make the Braxton Hicks version the method of choice in the treatment of placenta previa. Its effect on the fetus does not justify its condemnation. Cesarean section is emphasized as method of management of placenta previa.

Conservative management is stressed in the management of septic abortion. Habitual abortion is best combated with vitamin E in the form of a wheat germ oil. Progestin has given disappointing results.

The chapter on ectopic pregnancy is excellent. The subject is presented clearly and logically. Emphasis is placed on diagnosis and treatment. The authors state simply that the treatment is surgical. They wisely avoid the mention of "treatment of shock before operation" so frequently found in textbooks.

Normal labor is given generous consideration, its conduct is clearly described, and the subject is well illustrated. Emphasis is placed on obstetrical examination and diagnosis particularly that part dealing with abdominal palpation. Delivery in the presence of abnormal presentation is accomplished in a thoroughly conservative manner. The authors are to be congratulated upon the stress placed upon fundamentals throughout the text. Each phase of obstetrics receives studied consideration. A complete bibliography is contained in the book.

C. C. DOWERY

THE unique ray atlas of Kaplan and Rubinfeld, contains 35 full page plates, showing the anatomical position of organs and structures to be treated and visualized in relation to essential surface landmarks. Each plate shows at glance the visible surface landmarks, the palpable internal landmarks, the internal part or parts to be irradiated, and the placement of the treatment cone with respect to these landmarks so as to direct the irradiation to the affected area and to avoid the surrounding intervening normal tissues. The book is so arranged that

concise description of the anatomical landmarks, position of the cone and its direction appears on the page opposite each plate. While there may be some disagreement as to certain settings, the topographic drawings will readily apply to any method which the therapist may wish to employ. The material in this atlas is based on the rich experience of the authors at the Bellevue Hospital.

Radiologists should find it most helpful in the teaching and training of young men as well as in explaining their procedures to their colleagues. The

atlas will be of interest to any physician who treats disease amenable to x ray therapy.

EARL F. BARTK.

THE second edition of Flisfeld's well written volume of 260 pages is an admirable and concise presentation of the subject of infections of the hand, and should be a helpful guide to students and practitioners.

An excellent beginning chapter on the anatomy of the hand is followed by a chapter on prophylaxis of infections, and by subsequent chapters—first, on the simple infections, then on infections of the tendon sheaths, of the fascial spaces, on osteomyelitis, lymphangitis, and finally by a chapter on prognosis and on infections from the standpoint of arthritic compensation.

To cite a few points on which one might raise question concerning the author's advice should not detract from the commendation expressed concerning the volume as a whole. The statement on page

8 that clinically connection (between radial bursa and ulnar bursa at the wrist) may also be assumed may lead to unnecessary incisions in the presence of infection, and to adding injury and further infection in cases in which an infection from the radial bursa had not extended to the ulnar bursa, or vice versa. The horseshoe incision, depicted on page 36 should never be necessary to drain an infection of the distal phalanx. Such an incision always requires a long time for healing and leaves definite disability.

The value of conservative treatment of bone and joint infection has been frequently demonstrated. If the soft tissues are adequately drained, if immobilization is maintained, and if the surgeon persists in clean surgical care infection of bones and of joints will often subside and fingers will be saved instead of being sacrificed (page 68).

The incision almost from finger tip to wrist indicated on page 77 for draining the ulnar bursa, carries

definite risk of dividing completely the digital branch of ulnar nerve, the cleft between the little and ring fingers, and would almost certainly result in long delay in healing and in deforming and contracting scar. The digital sheath of the little finger can be drained by an incision on the ulnar side of the finger, the main portion of the ulnar bursa by an incision represented by the proximal one-third of the incision advised. The long continuous incision is not necessary.

To drain the middle palmar space one could prefer an incision along the distal flexor crease of the palm rather than the critical incisions indicated on page 84. The bilateral incisions indicated on page 66 to drain the retroflexor space above the wrist are rarely necessary and tempt the surgeon to invert through-and-through drains—measure definitely conducive to destruction of tendons and tendon

sheaths. An adequate incision on the ulnar side invariably provides effective drainage.

One should repeat that the volume as a whole is well written and the entire subject is admirably presented. The editor of the second edition deserves great credit for his excellent and well illustrated portrayal of the subject. SUMNER L. KOCH

THE authors of the noteworthy volume *The 1939 Year Book of Radiology*<sup>1</sup> again present an excellent and concise review of the literature dealing with radiology. An unusual amount of material has been obtained from non-radiologic sources and, as stated by the authors, "one must reflect on the possibility that our specialty is being gradually expropriated by other practitioners." A perusal of this book will reveal many significant and outstanding contributions during the past year. Visualization of the chambers of the heart and the great vessels after the intravenous injection of diodrast deserves special recognition.

Although there have been no new or startling discoveries in the field of radiation therapy, one cannot help but be impressed by the vast amount of research which is being done to determine the cause of cancer and its control. More and more new data are being accumulated regarding supervoltage x-ray therapy. A considerable difference of opinion exists as to its value. One gathers the impression that the results thus far do not warrant the replacement of the usual 200 kilovolt unit procedure. There has been continued interest in the use of contact therapy, particularly in the treatment of superficial lesions. The value of irradiation in the treatment of inflammatory conditions is expressed in numerous articles.

This book is recommended without reservation to anyone interested in recent advances in the field of radiology. As in previous years, this excellent volume deserves a place in the library of all radiologists.

EARL E. BARTH

PROVIDING fundamental knowledge of endocrine physiology and disease in the female, Hamblen's *Endocrine Gynecology*<sup>2</sup> is an excellent book for students and medical practitioners. The basic functions of "intra-uterine growth, birth, postnatal development, sexual differentiation, maturation, sexual activity, and reproduction" are considered. The rôle of the endocrine glands in these processes forms the subject matter of the book.

It is divided as follows: part I, sex endocrine principles, which provides a thorough review of the hormones with description of the commercial forms

available, part II, gynecic physiology, which covers growth, development and adolescence, the female function of maturity including the menstrual and gestational cycles, and the physiology of the climacteric, part III, diagnostic procedures in endocrine gynecology and sex-endocrine syndromes, this and the next section on abnormalities of growth and sexual differentiation are an excellent review of general endocrinology. They are illustrated by exquisite line drawings of examples of the various endocrine syndromes at different ages compared with the normal. Sections VIII and IX take up abnormal uterine bleeding and disorders of menstruation. Section X covers the endocrine aspect of sterility, section XI, the abnormalities of gestation, and section XII, complications of the climacteric. The gross and microscopic pathology of the uterus and ovaries is profusely illustrated by drawings. The study of hormone excretion is thoroughly charted and discussed. Each section has a bibliography.

This work is to be strongly recommended to the pediatrician and internist as well as the surgeon, obstetrician, and gynecologist. PAUL STARR.

THAT a textbook of surgery<sup>3</sup> should pass through five editions in the brief period of 9 years is a tribute to the industry and indefatigability of its author as well as a gauge of its well deserved popularity. We would add our congratulations to the many the author has received, and express again our admiration of his work. To have presented such a mass of material in so attractive and readable a form, to have chosen illustrations that tell their story with a minimum expenditure of space and with no unnecessary flourish, to have provided an interesting background of medical history are achievements that require both scholarship and craftsmanship. To these qualifications there have been added the judgment and discernment that come with years of surgical practice, and the willingness to weigh and consider new methods and new ideas.

The present generation of students and practitioners is fortunate in the men who have made accessible for them the great body of surgical knowledge in such attractive and accessible form, for the textbooks of Homans, Christopher, and Cole and Elman have set a standard that will be a "goal to shoot at" for many years to come.

The jacket of the fifth edition of Homans' textbook lists more than 130 subjects which have been reviewed again with the addition of fresh material, or which represent innovations in the present edition. We have verified the majority of them and agree with the publishers that this new edition deserves unstinted praise.

SUMNER L. KOCH

<sup>1</sup>1939 YEAR BOOK OF RADIOLOGY. DIAGNOSIS. Edited by Charles A. Waters, M.D. and Whitner B. Firor, M.D. THERAPEUTICS. Edited by Ira I. Kaplan, B.Sc., M.D. Chicago, Ill. The Year Book Publishers, Inc., 1939.

<sup>2</sup>ENDOCRINE GYNECOLOGY. By E. C. Hamblen, B.S., M.D., F.A.C.S. Foreword by J. B. Collip, M.D. Springfield, Ill. and Baltimore, Md. Charles C. Thomas, 1939.

<sup>3</sup>A TEXTBOOK OF SURGERY. By John Homans, M.D. 5th ed. Springfield, Ill. and Baltimore, Md. Charles C. Thomas, 1940.

## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

**TREATMENT OF DISEASES OF THE PERIPHERAL ARTERIES.** By Saul S. Sarnoza, A.M., M.D. 2d ed. London, New York, Toronto: Oxford University Press, 1940.

**EARLY DIAGNOSIS OF THE ACUTE ABDOMEN.** By Zachary Cope, B.A., M.D. M.S. (Lond.) F.R.C.S. (Eng.) 4th ed. London: Oxford University Press, 1940.

**DIAGNOSIS AND TREATMENT OF HEAD INJURIES.** By Sidney W. Gross, M.D. F.A.C.S., and William Ehrlich, M.D. Introduction by Percival Bailey, M.D. Ph.D. New York and London: Paul B. Hoeber, Inc., 1940.

**UNITED STATES NAVY DEPARTMENT, BUREAU OF MEDICINE AND SURGERY. ANNUAL REPORT OF THE SURGEON GENERAL, U.S. NAVY TO THE SECRETARY OF THE NAVY. CONCERNING STATISTICS OF DISEASES AND INJURIES IN THE UNITED STATES NAVY FOR THE CALENDAR YEAR 1938.** Washington: United States Government Printing Office, 1940.

**MYOMYOMAS.** By Frederick Christopher S.B., M.D. F.A.C.S. With Foreword by Allen B. Kanavel, M.D. F.A.C.S. 4th ed. Philadelphia and London: W. B. Saunders Co., 1940.

**THE FOOT AND ANKLE, THEIR INJURIES, DISEASES, DEFORMITIES AND DISMEMBERS.** By Philip Lewis, M.D. F.A.C.S. Philadelphia: Lea & Febiger, 1940.

**THE CHRISTIE HOSPITAL - NO HOLT RADON INSTITUTE. MANCHESTER. STATISTICAL REPORT OF THE RESULTS OF RADON THERAPY IN THE TREATMENT OF MALIGNANT DISEASES. Compiled 1930. Printed by Rowland Berry & Co. Ltd. Stockport.**

**ST THOMAS'S HOSPITAL REPORTS.** Edited by Prof. D. L. V. S. De Winton. Mr. C. M. Page assisted by Mr. N. R. Barrett, Dr. J. St. C. Elkington, Dr. A. J. Wrigley. 3d series. Vol. I. London: St. Thomas' Hospital, 1939.

**BIOLOGICAL SYMPOSIA.** Vol. I. Edited by Jacques Cattell. With Foreword by Albert F. Blakeslee. Lancaster, Pa.: The Jacques Cattell Press, 1940.

**THE PERINEAL ORGANS. THE COMPARATIVE ANATOMY OF MEDIAN AND LATERAL FISTULAE, WITH SPECIAL REFERENCE TO THE ORIGIN OF THE PERINEAL BODY - A DESCRIPTION OF THE HUMAN PERINEAL ORGANS. CONSIDERED FROM THE CLINICAL AND SURGICAL STANDPOINTS.** By Reginald J. Glanville, M.D. F.R.C.S., F.R.S.E., D.F.H. and Carol P. G. Wakeley D.Sc., F.R.C.S., F.R.S.L., F.Z.S. F.A.C.S. F.R.A.C.S. Baltimore: The Williams & Wilkins Co., 1940.

**A SYNOPTIC OF SURGERY.** By Ernest W. Hey Groves, M.S. M.D. R.S.C. (Lond.), F.R.C.S. (Eng.). 14th ed. Baltimore: The Williams & Wilkins Co., 1940.

**ELECTROCARDIOGRAPHY.** By Chennery C. Maher B.S. M.D., and Paul H. Woska, M.D. M.S. 2d ed. Baltimore: The Williams & Wilkins Co., 1940.

**THE PULMONARY TRAIL.** By William F. Boos, M.D. Boston, New York: Hale, Cushman & Flint, 1939.

**SOFT NEURALISM, SOFTSPINDLING AND ALLIED COMPOUNDS IN INTELLECTUALITY.** By Maurice A. Schanck, M.D. Edited by Henry A. Christian, A.M., M.D. LL.D. Sc.D. (Hon.) F.A.C.P., Hon. F.R.C.P. (Can.) (Reprinted from *Oxford-Lancet Medicine*) New York, London, Toronto: Oxford University Press, 1940.

**THE COMPLETE PEDIATRIC PRACTICAL, DIAGNOSTIC, THERAPEUTIC AND PREVENTIVE PEDIC TRICE.** 3d ed. By Wilbert C. Davidson, M.A., D.Sc., M.D. Durham, N.C.: Duke University Press, 1940.

**AN ANATOMICAL ANALYSIS OF SPORTS.** By Gertrude Hawley M.A. New York: A. S. Barnes & Co., 1940.

**OPERATIVE SURGERY.** By J. Shelton Horsley, M.D. LL.D. F.A.C.S., and Isaac A. Bigger, M.D. With contributions by C. C. Coleman, M.D. F.A.C.S. John S. Horsley, J. M.D. Austin I. Dodson, M.D. F.A.C.S. and Donald M. Frazier, M.D. Vol. 1 and 2. 5th ed. St. Louis: The C.V. Mosby Co., 1940.

**CANCER, M.A. FOR PRACTITIONERS.** The Consultant on Publication, George W. Holmes, M.D. Channing, Sheldis Warren, M.D. Ernest M. Deland, M.D. Channing C. Simmons, M.D. Editor. Boston, Mass., 1940.

**CYCLOPOEDIA ANTHROPOLOGICA.** By Benjamin Howard Robbins, B.A., M.S. M.D. Baltimore: The Williams & Wilkins Co., 1940.

## CORRESPONDENCE

## RE-ESTABLISHMENT OF GASTRO-INTESTINAL PASSAGE AFTER GASTRIC RESECTION

*The Editor*—I letter in the April, 1941 issue of *SURGERY, GYNECOLOGY AND OBSTETRICS*, p. 853 D. J. Shelton Horsley writes that in my article which appeared in the February 5, 1940, issue under the title "Re-Establishment of Gastro-Intestinal Passage after Gastric Resection" an inaccuracy appears in connection with the mention of his method. I believe that this is a mistake, for the

description of D. Horsley operation on p. 75 February 5 issue tallies completely with that given by him in his textbook as well as in the statement contained in Dr. Horsley's letter. It is the form of end-to-end gastroduodenostomy. The legend for Figure 1 it is explicitly stated that it illustrates the method of J. Shelton Horsley and that it illustrates anterior end-to-side duodenogastrostomy as modified by Kocher. It is not an impossible operation as Dr. Horsley seems to think I have done it myself many times. E. OTTE POLTA.

Budapest Hungary

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

GEORGE P. MULLER, Philadelphia, *President*  
EVARTS A. GRAHAM, St. Louis, *President-Elect*

*Committee on Arrangements*  
JOHN A. WOLFER, *Chairman*, CHARLES B. PUESTOW, *Secretary*

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## PLANS FOR THE 1940 CLINICAL CONGRESS IN CHICAGO

THE 1940 Clinical Congress of the American College of Surgeons will be held in Chicago, October 21 to 25. This will be the thirtieth assembly of this great organization of surgeons of the United States, Canada and Latin America. The surgeons of Chicago are privileged to be hosts to the Congress for the eighth time since 1910, when the first large clinical program was organized under the sponsorship of the Clinical Congress of the Surgeons of North America. This year under the leadership of a strong and representative committee, it is planned to present a program of operative clinics and demonstrations covering all phases of the clinical activities of the five medical schools and forty or more hospitals which will participate. Representing, as it does, the interests of all surgical specialists as well as general surgeons, this meeting of the American College of Surgeons will provide a complete and varied program for all of those who will attend. During the five days of the meeting, there will be presentations of the latest advances in diagnostic methods, surgical technique, operative procedure and the aftercare of the surgical patient. Clinics and demonstrations will be held on the afternoon of Monday, October 21, and the mornings and afternoons of each of the four succeeding days.

### CLINICAL PROGRAM

An extensive schedule of operative clinics, in which the technique of a wide variety of surgical procedures will be demonstrated in the operating rooms, is being arranged by the committee as the major feature of the Congress. However, the program is being planned, in so far as possible, so that it will also cover related problems in diagnosis, pre- and postoperative care and other special aspects of the management of the surgical condition under consideration.

### EXECUTIVE COMMITTEE

John A. Wolfer  
Chairman  
Charles B. Puestow  
Secretary  
Fred L. Adair  
William E. Adams  
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Oscar E. Nadeau  
Eric Oldberg  
Samuel A. Salinger  
Charles F. Sawyer  
Kellogg Speed

A series of non-operative clinics and demonstrations is being planned which will present the various features of the clinical work being done in many of the hospitals. All of the special fields of surgery will be represented in the clinical program. These demonstrations will not only provide practical information on the latest advances in diagnostic and therapeutic methods, but will present important research work which is being carried on in the institutions of this large medical center.

A number of the larger hospitals are planning special scientific exhibits which will enable the visiting surgeon to study at first hand many of the clinical activities as well as the experimental work of the various institutions.

The program of each hospital and medical school is being arranged to cover subjects in general surgery, obstetrics and gynecology, fractures and other traumas, thoracic surgery, neurosurgery, urology, orthopedic surgery, ophthalmology, and otolaryngology. The presentation of subjects under these classifications is being so correlated that those attending the Congress will have the opportunity to devote their time continuously to clinics dealing with the specialty in which they are most interested. In order to aid the visiting surgeon in selecting clinics which he desires to attend, the daily clinical bulletin will present the program



according to the above classifications. The complete details of the clinical program for the succeeding day will be posted each afternoon in the form of bulletins at headquarters in the Stevens Hotel and distributed in printed form each morning.

#### EVENING SCIENTIFIC SESSIONS

The opening scientific session of the Clinical Congress will be held on Monday evening in the Ballroom of the Stevens Hotel, when the Presidential Meeting and Convocation will be combined. The new officers of the College will be inaugurated and the 1940 class of initiates received into fellowship. Distinguished surgeons from foreign countries will then be introduced, following which Dr. George P. Muller of Philadelphia, will deliver the presidential address. Principles of Colonic Surgery will be the subject of the sixth annual oration on surgery to be delivered by Dr. Fred W. Rankin, Lexington, Kentucky.

Scientific meetings will be held on Tuesday, Wednesday and Thursday evenings at headquarters, when distinguished members of the profession of national and international prominence will address the assembled guests of the Congress. The speakers and subjects of these addresses are being carefully selected to assure presentations which will be of interest to those practicing in all of the special fields of surgery. It is the desire of the Board of Regents to provide a program for the evening sessions that will cover as many of the latest advances in general surgery and the surgical specialties as possible. These scientific papers will be of such importance as to represent outstanding contributions to the surgical literature.

#### PANEL DISCUSSIONS

Panel discussions have met with such decided success at the Clinical Congress and sectional meetings of the College that the schedule this year will include 30 or more such conferences arranged for Monday, Tuesday, Wednesday and Thursday afternoons. Recognized authorities are co-operating with the College as leaders and collaborators of these panels and the topics which have been selected will cover many pertinent subjects in all fields of surgery. This program permits more informal discussion of the subjects than would be possible in larger meetings. The plan provides that the leader will present his subject within a ten minute period; collaborators will then discuss various phases briefly, after which general discussion from the floor will be encouraged. A list of topics which have been suggested for the panel discussions follows:

Posttraumatic head syndrome, anesthesia for patients with brain tumors, complications of thyroid surgery, tumors of the salivary glands, surgery in pulmonary tuberculosis, suppurative conditions of the lung, the place of radiation treatment of the breast, etiology and treatment of gastric hemorrhage, liver test and liver function in relation to biliary surgery, surgical diseases of the pancreas, intestinal obstruction, appendicitis, carcinoma of the colon, non-malignant diseases of the intestines, acute abdominal surgery in children, infections of the upper urinary tract, treatment of endocrine sterility in woman, anesthesia, analgesia, and amnesia in obstetrics, indications for cesarean section, early recognition of cancer of the uterus, healing of wounds, anesthesia, surgical bacteriology, immediate treatment of burns, infections of the hand, nutritional state of the patient (vitamins, proteins), management of diabetic extremities.

#### GROUP CLINICAL CONFERENCES

A new feature of considerable interest to all surgeons attending the Congress will be the series of group clinical conferences which is being arranged for Friday afternoon. Nine special fields of surgery have been selected and an important subject of current interest will be briefly presented in each conference. These special fields are: Fractures and other traumas, neurosurgery, obstetrics and gynecology, orthopedic surgery, plastic surgery, thoracic surgery and urology. Each leader is selecting the subject which will be presented. They will direct discussions from the floor and visitors attending the meeting will be invited to present any problem with which they may be concerned—one that is related to the special field under discussion. Recognized authorities will endeavor to answer these questions and offer as much helpful advice as possible. Everyone should benefit by participating in a consultation conference of this nature.

#### SYMPOSIUM ON CANCER

The Cancer Committee of the College has done outstanding work in furthering the development of cancer clinics in hospitals and providing for the registration of cured cases of malignant disease in the cancer archives. The chairman of this committee will give a brief review of these activities of the College in opening the symposium on cancer which will be held Wednesday afternoon. One of the scientific papers of this meeting will summarize the present status of cancer research. Other subjects of practical interest to be presented include various aspects of diagnosis and treatment of a variety of different types of cancer. The view

# CLINICAL CONGRESS PROGRAM IN BRIEF

(All sessions at the Stevens Hotel except as noted)

## Monday, October 21

- 10 00 Hospital Conference
- 1 30 Panel Discussions (5)
- 2 00 Clinics in Chicago hospitals
- 2 00 Hospital Conference
- 2 00 Surgical Film Exhibition, General Surgery
- 3 00 Assembly of Initiates, followed by reception—  
Headquarters of College
- 3 30 Panel Discussions (5)
- 8 00 Presidential Meeting and Convocation

## Tuesday, October 22

- 9 00 Clinics in Chicago hospitals
- 9 30 Hospital Conference
- 9 30 Surgical Film Exhibition, Eye, Ear, Nose and  
Throat Surgery
- 10 00 Surgical Film Exhibition, General Surgery
- 11 00 Group Conferences, Eye, Ear, Nose and Throat  
Surgery (2)
- 1 30 Panel Discussions (5)
- 2 00 Clinics in Chicago hospitals
- 2 00 Hospital Conference
- 2 00 Symposium on Fractures and Other Traumas
- 2 00 Surgical Film Exhibition, General Surgery
- 3 30 Panel Discussions (5)
- 8 00 Scientific Session, General Surgery
- 8 00 Scientific Session, Ophthalmology
- 8 00 Scientific Session, Otorhinolaryngology
- 8 00 Hospital Conference

## Wednesday, October 23

- 9 00 Clinics in Chicago hospitals
- 9 30 Hospital Conference
- 9 30 Surgical Film Exhibition, Eye, Ear, Nose and  
Throat Surgery
- 9 30 State and Provincial Judiciary Committees
- 10 00 State and Provincial Credentials Committees
- 11 00 State and Provincial Executive Committees

- 11 00 Group Conferences, Eye, Ear, Nose and Throat  
Surgery (2)
- 12 00 Meeting of Board of Governors
- 1 30 Panel Discussions (5)
- 2 00 Clinics in Chicago hospitals
- 2 00 Hospital Conference
- 2 00 Symposium on Cancer
- 2 00 Surgical Film Exhibition, General Surgery
- 3 30 Panel Discussions (5)
- 7 00 Surgical Film Exhibition, Eye, Ear, Nose and  
Throat Surgery
- 8 00 Scientific Session, General Surgery
- 8 00 Joint session, ophthalmology and otolaryngology
- 8 00 Hospital Conference

## Thursday, October 24

- 9 00 Clinics in Chicago hospitals
- 9 30 Hospital Conference
- 9 30 Surgical Film Exhibition, Eye, Ear, Nose and  
Throat Surgery
- 10 00 Surgical Film Exhibition, General Surgery
- 11 00 Group Conferences, Eye, Ear, Nose and Throat  
Surgery (2)
- 1 30 Annual Meeting, Fellows of the College
- 2 00 Clinics in Chicago hospitals
- 2 00 Hospital Conference
- 3 00 Round Table Conference, Graduate Training for  
Surgery
- 3 30 Panel Discussions (5)
- 3 30 Surgical Film Exhibition, General Surgery
- 3 30 National and Regional Fracture Committees
- 8 00 Scientific Session, General Surgery
- 8 00 Scientific Session, Ophthalmology
- 8 00 Scientific Session, Otorhinolaryngology

## Friday, October 25

- 9 00 Clinics in Chicago hospitals
- 10 00 Surgical Film Exhibition, General Surgery
- 11 00 Surgical Film Exhibition, Eye, Ear, Nose and  
Throat Surgery
- 2 00 Clinics in Chicago hospitals
- 2 00 Group Clinical Conferences (9)
- 2 00 Surgical Film Exhibition, General Surgery

points of the surgeon, the radiologist, and the pathologist will be correlated in this symposium and those who attend will learn of the latest thought concerning the treatment of cancer

## SYMPOSIUM ON FRACTURES AND OTHER TRAUMAS

In this symposium to be held on Tuesday afternoon, the chairman of the Committee on Fractures and Other Traumas will make a brief statement concerning the work of this important committee. The scientific papers to be presented at this meeting will emphasize practical subjects dealing with various types of fractures which present special problems in management and treatment. This program affords an opportunity to learn of different viewpoints regarding the handling of clinical problems in the treatment of fractures and other traumas. All surgeons who engage in this type of work will benefit from the discussions in this important meeting of the Congress.

## OPHTHALMOLOGY AND OTOLARYNGOLOGY

A new departure from the proceedings of the Congress in former years is being arranged in ophthalmology and otolaryngology. Separate sessions scheduled for Tuesday and Thursday evenings will include panel discussions and symposia on important subjects in these fields. The leaders and a group of outstanding surgeons will direct the discussions in these meetings so as to cover many phases of a general subject in each of the specialties and a number of different viewpoints will be expressed. On Wednesday evening, there will be a joint session of ophthalmologists and otolaryngologists with a symposium on the important subject 'Primary Treatment of Injuries about the Face.' An ophthalmologist, an otolaryngologist, a maxillofacial surgeon, a neurosurgeon and a general surgeon will cover all aspects of this subject. This type of program promises to attract wider interest than the usual presentation of formal papers.

Clinics in Chicago hospitals each morning and afternoon for the visiting ophthalmologists and otolaryngologists will demonstrate surgical work of a wide variety. On Tuesday Wednesday and Thursday mornings, in addition to the hospital program, there will be clinical conferences for each group of specialists at the headquarters hotel. These are being arranged so that the leader will briefly survey the field for discussion in a ten minute period. The large meeting of surgeons will then be broken up into small groups, limited to 20 and under separate leaders, where there will be an opportunity for everyone to ask questions and participate in the discussions. Each visitor will select in advance the small section of the meeting which he wishes to attend. In this manner the general subject may be discussed thoroughly and each will benefit by the experience and different viewpoints of his colleagues. The success of these conferences is assured. The morning meetings will be preceded by the showing of selected surgical motion picture films. The subjects which have been selected for the scientific program in ophthalmology and otolaryngology are as follows:

#### OPHTHALMOLOGY

*Group Conferences—Tuesday Wednesday and Thursday*  
100 21

Surgical Indications in Glaucoma  
Surgical Management of Injuries to the Eye  
Minor Surgery in Ophthalmology

*Scientific Sessions—Tuesday Wednesday and Thursday*  
8 to 9 p.m.

Panel Discussion—Surgery of Squint  
Symposium—Advances in Ophthalmic Surgery: Cataract, Glaucoma, Retinal Detachment  
Joint session of ophthalmologists and otolaryngologists  
Primary Treatment of Injuries about the Face. (Participants: Neurosurgeon, ophthalmologist, otolaryngologist, oculo-facial surgeon)

#### OTOLARYNGOLOGY

*Group Conferences—Tuesday Wednesday and Thursday*  
100 21

Role of Chemotherapy in Suppurative Diseases of the Middle Ear Spaces  
Indications for Surgery in Sinus Disease  
Osteomyelitis of the Skull Bones

*Scientific Sessions—8 to 9 p.m.*

Tuesday—Symposium: Meniere's Disease, Medical Treatment, Use of Histamine Surgical Treatment

Wednesday—Joint Session of Ophthalmologists and Otolaryngologists: Primary Treatment of Injuries about the Face. (Participants: Neurosurgeon, ophthalmologist, otolaryngologist, oculo-facial surgeon)

Thursday—Body Section: Roentgenography in Relation to Diagnosis in Diseases of the Nasal Accessory Sinuses

#### GRADUATE TRAINING IN SURGERY

Following the annual meeting of the fellows, to be held on Thursday afternoon there will be a panel discussion on graduate training in surgery.

The chairman of the committee of the College which represents the surgical specialist as well as the general surgeon will summarize the work which has been done during the past three years. Following this report, there will be one formal paper dealing with plans of graduate training in surgery in hospitals which have no direct medical school connections. The teaching methods employed in educational programs in institutions of this type will be described in detail. The meeting will then be turned over to informal discussions from the floor. The leader will direct these discussions on the problems presented in developing graduate training in hospitals where undergraduate teaching may be limited or entirely lacking. This program should elicit the interest of all hospital executives, surgeons, and educators who are concerned with the future standards of surgery in the United States and Canada.

#### HOSPITAL CONFERENCES

The twenty-second annual hospital standardization conference will open the Clinical Congress with a meeting at the headquarters hotel on Monday morning 8 to 10 o'clock. The report of the 1940 hospital standardization survey—official announcement of the list of approved hospitals and hospitals approved for graduate training in surgery will be made at this session. Throughout the week there will be a series of hospital meetings with round table conferences, panel discussions, group conferences, and practical demonstrations dealing with all phases of hospital administration and various problems related to management, efficiency and education in the hospital. Several hospital conferences will be devoted to subjects of vital interest to hospital executives and members of governing boards.

At a joint session with the Association of Record Librarians of North America the subject of medical records will receive special consideration from the standpoint of their relationship to the clinical work of the physician and the medical and surgical specialist.

A panel discussion will be devoted to problems related to administration in the small hospital where those who are interested may give exclusive consideration to the management and operation of the type of institution which serves the small community. A series of group conferences is being arranged for Thursday morning where the problems which are of interest to different departmental groups of hospital personnel will be considered. This will permit informal discussions and enable the leader of each small group to adequately cover a number of pertinent questions.

related to various hospital departments. There will also be round table conferences where an opportunity will be afforded everyone to consult with recognized leaders in the hospital field on any question or problem on which specific information has not been presented in the general program. This should act as a final clearing house of discussion for the entire hospital conference.

A group of Chicago hospitals plan a large series of exhibits and demonstrations for the hospital visitors. These demonstrations will cover all phases of hospital activity and offer an opportunity for study of the latest methods and techniques used in the administrative, nursing, outpatient, and other departments of the hospital. The professional personnel and medical staffs of these institutions will co-operate in this extensive display of the hospital in action. In addition, there will be ample opportunity during the week of the Congress for visitors to inspect the hospitals in Chicago and vicinity.

#### ANNUAL MEETINGS OF COMMITTEES

The annual meetings of the State and Provincial Judiciary, Credentials, and Executive Committees will be held on Wednesday morning. These committees have an important function to perform in the activities of the College. The Credentials Committees and the Committees on Applicants provide an organization which constitutes one of the largest and most carefully deliberate accrediting bodies which exist in the medical profession. Through this organization, the standards of fellowship are maintained and each fellow of the College has a definite responsibility in this work. All members of each of these committees are urged to attend these important sessions.

#### ANNUAL MEETING OF THE FELLOWS

The annual meeting of the Fellows will be held on Thursday afternoon. The American College of Surgeons has been a potent force which has not only materially raised the professional and ethical standards of surgery, but has also promoted good hospitalization and general improvement in the practice of medicine in the United States and Canada. These activities have received wide recognition by professional groups and the public as well. Each individual fellow of the College has a part in this work and may extend its influence materially in his local community. Hospital standardization alone offers him unlimited opportunity to provide better medical care for his patients in the hospital in which he works through continuous progress in applying the principles of the minimum standard. Approval of hospitals,

plans for graduate training in surgery, cancer clinics, medical service in industry, medical motion pictures, the annual Clinical Congress, and the sectional meetings represent a vast educational program.

The annual meeting of the Fellows affords the officials of the College an opportunity to report on the activities of the organization and to receive suggestions from those who have made possible the conduct of these activities. Every fellow of the American College of Surgeons will want to attend this important meeting and participate in the program if he so desires.

#### PUBLICATION OF PROCEEDINGS

As in former years, the formal papers which are presented at the scientific sessions of the Congress will be published in a special issue of the official journal of the College, *SURGERY, GYNECOLOGY AND OBSTETRICS*, in February following the meeting. This is furnished without additional charge to all Fellows, junior candidates, and others who register for the Congress as invited guests. The papers which are presented in connection with the Hospital Standardization Conference are published in subsequent issues of the *Bulletin* of the American College of Surgeons.

#### ADVANCE REGISTRATION

The hospitals and medical schools of the Chicago area afford accommodations for a large number of visiting surgeons, but to insure against overcrowding, attendance at the Congress will be limited to the number that can be comfortably accommodated at the clinics. The limit of attendance will be based on a survey determining the available facilities in the participating hospitals and schools. It is expected, therefore, that surgeons who wish to attend the Congress will register in advance.

A registration fee will be required in order to provide funds with which to meet expenses of the meeting. A formal receipt will be issued to each surgeon registering in advance which will be exchanged for a general admission card upon presentation at headquarters during the Congress. This card, which is not transferable, must accompany all requests for clinic tickets and be presented for admission to the scientific sessions.

A resolution adopted by the Board of Regents provides that the registration fee for fellows of the College and endorsed junior candidates shall be \$5.00, that no fee for the 1940 Clinical Congress shall be required of initiates (class of 1940), that the fee for surgeons who are not Fellows attend-

ing as invited guests of the College shall be \$ 0.00.

As in previous years, admission to clinics and demonstrations in the hospitals and certain of the scientific meetings at headquarters will be controlled by means of tickets. This plan provides for the distribution of visiting surgeons at the various clinics and other meetings and helps to insure against overcrowding. The number of tickets issued for any clinic will be limited to the capacity of the room in which the clinic is held. Visiting surgeons are urged to co-operate in making the clinic ticket plan a success.

#### HEADQUARTERS—TECHNICAL EXHIBITION

Headquarters for the Congress will be established at the Stevens Hotel where there are unusual facilities for accommodating the Congress. All of the public rooms have been reserved for conferences, registration ticket bureaus, clinic bulletins, executive offices and scientific exhibits. Thus, all activities of the Congress, except the clinical program, will be located under one roof.

The technical exhibition together with the registration desk will be located on the lower floor of the Stevens Hotel in the large exhibition hall. Leading manufacturers of surgical instruments and supplies, sutures, dressings, pharmaceuticals,

operating room equipment, x-ray apparatus and hospital equipment of all kinds, as well as publishers of medical books will be represented in the exhibition. It will provide for the visiting surgeons an opportunity of carefully inspecting the finest modern products of all those industries which are aiding the work of the surgeon and the hospital.

#### CHICAGO HOTELS AND THEIR RATES

In addition to the headquarters hotel, the Stevens, there are several first-class hotels within short walking distance of headquarters, providing ample hotel facilities at reasonable rates. It is suggested that reservation of hotel accommodations be made at an early date. The following hotels are recommended by the Committee:

	Minimum Rate per Day	
	Single	Double
Auditorium, 490 S. Michigan Ave.	\$ 30	\$ 40
Blenheim, 7 W. Randolph St.	30	40
Blackstone, Michigan Ave. at 7th St.	4 00	6 00
Congress, 900 S. Michigan A.	3 00	5 00
Drake, Michigan and Lake Shore Dr.	4 00	6 00
Harrison, 17 E. Harrison St.	00	3 00
LaSalle, 70 N. LaSalle St.	30	4 00
Morrison, 79 W. Madison St.	30	4 00
Palmer House, 5 E. Madison St.	3 00	5 00
Sherman, 66 W. Randolph St.	30	4 00
Stevens, 730 S. Michigan Ave.	3 00	4 50

# SURGERY

## GYNECOLOGY AND OBSTETRICS

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NUMBER 2

### GASTROSCOPIC OBSERVATIONS IN CASES OF GASTRIC DISTRESS FOLLOWING OPERATIONS ON THE STOMACH

HERMAN J. MOERSCH, M.D., and WALTERMAN WALTERS, M.D., F.A.C.S.,  
Rochester, Minnesota

**G**ASTRIC distress which develops after an operation on the stomach often presents a difficult diagnostic problem. This is attributable to the inconsistency of symptoms and the difficulty of roentgenographic interpretation as a result of disturbance of the normal anatomy of the stomach. Any procedure, therefore, that can assist in the better evaluation of the cause of the distress deserves the most careful consideration. Gastroscoy, in our opinion, is a procedure that will be found of definite value in the study of the stomach after operation.

Schindler, in 1922, first called attention to the possible value of gastroscoy in the study of the stomach after operation. Since then, scant attention has been given to this interesting problem. It seems advisable, therefore, to present a review of the gastroscoy findings in 100 consecutive cases in which an operation had been performed on the stomach and gastric distress developed subsequently. This latter point must be especially emphasized, for this study cannot be interpreted in any way as illustrating what occurs in the average stomach following operation, rather, it is meant to demonstrate the course of events in the stomach of the patient who has subsequent gastric difficulty.

From the Divisions of Medicine and Surgery, the Mayo Clinic

With the Wolf-Schindler flexible gastroscope it is possible to obtain a highly satisfactory view of the interior of the stomach in most cases after operation on the stomach. Many observers stress the point that orientation is much more difficult in the stomach after operation than in the intact stomach. In our experience, if the type of operation that had been performed was known before gastroscoy examination, little difficulty was encountered in this respect. In cases in which partial gastrectomy had been done, we were able to obtain a satisfactory view of the stoma in every instance. More difficulty was experienced in examining the stoma after gastroenterostomy. However, a satisfactory view could be obtained in more than 80 per cent of such cases.

Even when the entire stoma cannot be observed, a partial view, as Lintott has pointed out, can be of definite value, for "inflammatory changes present at the stoma are seldom strictly localized." Often, it is possible to observe both the gastro-enteric stoma and the antral portion of the stomach in the same gastroscoy field, and thus an opportunity is afforded to compare the peristaltic activity about the opening with that of the antrum of the stomach. Our observations are in agreement with those of Schindler (3), that the



Fig. Gastritis



Fig. 2. Erosive gastritis



Fig. 3. Gastrojejunal ulcers at site of anastomosis.



Fig. 4. Carcinoma at site of anastomosis.

*Gastroscopic Observations in Cases of Gastric Distress Followed Operations on the Stomach—Herman J. Macrack and Wallace H. Myers*

# SURGERY

## GYNECOLOGY AND OBSTETRICS

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### GASTROSCOPIC OBSERVATIONS IN CASES OF GASTRIC DISTRESS FOLLOWING OPERATIONS ON THE STOMACH

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**G**ASTRIC distress which develops after an operation on the stomach often presents a difficult diagnostic problem. This is attributable to the inconsistency of symptoms and the difficulty of roentgenographic interpretation as a result of disturbance of the normal anatomy of the stomach. Any procedure, therefore, that can assist in the better evaluation of the cause of the distress deserves the most careful consideration. Gastrosocopy, in our opinion, is a procedure that will be found of definite value in the study of the stomach after operation.

Schindler, in 1922, first called attention to the possible value of gastrosocopy in the study of the stomach after operation. Since then, scant attention has been given to this interesting problem. It seems advisable, therefore, to present a review of the gastrosocopic findings in 100 consecutive cases in which an operation had been performed on the stomach and gastric distress developed subsequently. This latter point must be especially emphasized, for this study cannot be interpreted in any way as illustrating what occurs in the average stomach following operation, rather, it is meant to demonstrate the course of events in the stomach of the patient who has subsequent gastric difficulty.

With the Wolf-Schindler flexible gastroscope it is possible to obtain a highly satisfactory view of the interior of the stomach in most cases after operation on the stomach. Many observers stress the point that orientation is much more difficult in the stomach after operation than in the intact stomach. In our experience, if the type of operation that had been performed was known before gastrosocopic examination, little difficulty was encountered in this respect. In cases in which partial gastrectomy had been done, we were able to obtain a satisfactory view of the stoma in every instance. More difficulty was experienced in examining the stoma after gastroenterostomy. However, a satisfactory view could be obtained in more than 80 per cent of such cases.

Even when the entire stoma cannot be observed, a partial view, as Lintott has pointed out, can be of definite value, for "inflammatory changes present at the stoma are seldom strictly localized." Often, it is possible to observe both the gastro-enteric stoma and the antral portion of the stomach in the same gastrosocopic field, and thus an opportunity is afforded to compare the peristaltic activity about the opening with that of the antrum of the stomach. Our observations are in agreement with those of Schindler (3), that the

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TABLE I.—OPERATIVE PROCEDURES IN 100 CASES OF GASTRIC LESIONS

Operation and condition	Cases
Posterior gastro-entrostomy for duodenal ulcer	6
Partial gastrectomy for duodenal ulcer	9
Partial gastrectomy for gastric ulcer	3
Posterior gastro-entrostomy and knife excision for gastric ulcer	2
Resection for carcinoma	3
Miscellaneous procedures	
Knife excision for duodenal ulcer and gastro-duodenostomy	5
Pyloroplasty for gastric ulcer	
Pyloroplasty for duodenal ulcer	
Knife excision for duodenal ulcer with reconstruction of pylorus	
Total	100

*Gastroscopy was performed in each of these 100 cases because of post-operative gastric distress.*

peristaltic activity of the antrum of the stomach and at the gastro-enteric opening are not synchronous. Furthermore, peristaltic activity at the stoma is often absent in the presence of gastritis. Although we strongly suspect that absence of peristaltic activity at the gastro-enteric stoma may be a factor in the development of postoperative gastritis, still this is not always true. It is conceivable that a lack of activity at the stoma may occur as a result of gastritis, rather than vice versa.

The two greatest obstacles in carrying out a satisfactory gastroscopic examination after operation on the stomach are the presence of a bubbly, bile-stained secretion which may be regurgitated through the gastro-enteric stoma and may obscure the gastroscopic field, and the placing of the stoma in such a position especially in obese individuals, that it defies satisfactory visualization in spite of all maneuvers.

The actual amount of jejunal mucosa that can be examined in any given case through the gastroscope is dependent on the size and position of the stoma. Often it is possible to look down a barrel of the jejunum for a distance of several inches. The jejunal mucosa is readily distinguished from the gastric mucosa by its color and the regular disposition of the valvulae conniventes.

The 100 cases to be reported are classified in Table I according to the type of operative procedure which had been employed and the condition for which the operation had been done. Gastro-entrostomy for duodenal ulcer

was the most common procedure. This was to be anticipated as it is an operation that has been employed more extensively and for a longer period than any other. Seventy-five of the patients were men and 25 women. While a slightly higher percentage of men than of women had evidence of organic disease as seen through the gastroscope the difference was so slight in this series that it was not deemed advisable to separate the group as to sex.

#### OBSERVATIONS AFTER GASTRO-ENTEROSTOMY FOR DUODENAL ULCER

The gastroscopic findings in the cases in which gastro-entrostomy had been done for duodenal ulcer are given in Table II. Probably the most striking observation was that 19, or 30.6 per cent, of the patients in this group had an apparently normal mucosa. This compares closely with what was found in the series as a whole, as the stomach in 30 of the 100 cases was classified gastroscopically as normal. It is of interest to compare our observations with those of Schindler (3) who found the stomach normal in only 22.2 per cent of 1,000 cases in which routine gastroscopic examinations were performed and only 3 of 30 stomachs examined after operation were normal. The discrepancy is more than likely to be attributable to difference of opinion as to what constitutes the borderline between the normal gastric mucosa and the early changes of gastritis. There is also the important factor of time at which the gastroscopic examination was performed. It is well known that the gastroscopic picture does not always remain constant and can change from time to time. After an acute infectious process, indiscretion in diet or other factors there may be definite evidence of gastritis which may be absent at a subsequent examination. It might be anticipated that the longer the period of time that is allowed to elapse between operation on the stomach and gastroscopic examination, the less the likelihood of encountering gastritis. Contrary to expectation, this was not found true in our cases.

The thought naturally presents itself what accounted for the postoperative gastric distress in the 9 cases in which gastro-entrostomy had been performed and the gastric

TABLE II—CONDITION OF STOMACH DISCLOSED BY GASTROSCOPY AFTER VARIOUS OPERATIONS IN 100 CASES OF POSTOPERATIVE GASTRIC DISTRESS

Condition of stomach	Operation for duodenal ulcer		Miscellaneous procedures	Operation for gastric ulcer		Pyloroplasty	Resection for carcinoma
	Gastro-enterostomy	Partial gastrectomy		Gastro-enterostomy and knife excision	Partial gastrectomy		
Apparently normal mucosa	19	6	1	1	1	1	1
Gastritis	28	3	1	5	1		1
Erosive gastritis	6	9	2				
Carcinoma	2			1	1		1
Benign tumor	1						
Gastric ulcer	1			1			
Gastrojejunal ulcer	5	1					
Total	62	19	4	8	3	1	3

mucosa was normal on gastroscopic examination? In each case, the clinical history was that of an indefinite type of gastric distress, except for one case in which gastric bleeding had occurred. All patients except the one with hemorrhage were placed under medical management and their symptoms were relieved. In this group, the functional element appeared predominant. The patient with a history of gastric bleeding was subjected to partial gastrectomy. Although the patient has had no further bleeding since operation, the surgeon was unable to discern any abnormality of the gastric mucosa.

Thirty-four, or 54.8 per cent of the patients who had undergone gastro-enterostomy for duodenal ulcer, had gastroscopic evidence of gastritis. It is probably not advisable to attempt to subdivide the cases of postoperative gastritis into the various classes used for cases of gastritis of the pre-operative stomach, for practically every variety of gastritis may be seen in the same stomach (Fig 1). There is, however, one variety which is characterized by multiple small erosions or areas of ulceration scattered throughout the gastric mucosa (Fig 2) which, because it gives rise to more distinct symptoms and responds satisfactorily to therapeutic management, will be placed in a separate group and classified as erosive gastritis.

There were 6 cases of erosive gastritis and 28 cases of gastritis of other types in the group in which gastro-enterostomy had been performed for duodenal ulcer. The clinical course

in the 28 cases of gastritis was distinctly different from that in which the gastric mucosa was normal on gastroscopic examination. In the latter group, the response to medical management was highly satisfactory. In the former the response to treatment was far from satisfactory and 7 of the 28 patients who had gastritis were subjected to subsequent gastric operation, and even then the results were not always satisfactory. In every case which came to operation, there was gross and microscopic evidence of gastritis.

Although the gastroscopist is prone to claim the domain of gastritis as his own, it is interesting to note that the roentgenologist ventured a diagnosis of gastritis in 8 of the 28 cases of gastritis after gastro-enterostomy for duodenal ulcer before gastroscopy had established that diagnosis.

In all 6 cases in this group in which a diagnosis of erosive gastritis was made, gastric bleeding had occurred at some time following gastro-enterostomy. The clinical history slightly simulated that of gastrojejunal ulcer. Because of this fact, surgical exploration for gastrojejunal ulcer was performed in 3 cases, although gastroscopic and roentgenoscopic examinations failed to reveal gastrojejunal ulcer. In all 3 cases, no gastrojejunal ulcer could be found but in each case, evidence of gastrojejunitis with multiple erosions of the gastric mucosa was found at operation.

A diagnosis of gastrojejunal ulcer was made from the gastroscopic findings in 5 of the cases in which gastro-enterostomy had been

performed for duodenal ulcer (Fig 3) In 3 of the 5 cases surgical exploration was performed In each case the diagnosis of gastrojejunal ulcer was confirmed both surgically and on pathological examination In the 2 other cases medical treatment was used so that pathological confirmation of the gastroscopic findings could not be made.

A gastric ulcer was found on gastroscopy In one of the cases in which gastro-enterostomy had been carried out for duodenal ulcer This apparently developed 8 years after the gastro-enterostomy The patient was placed on an ulcer diet with relief of symptoms and disappearance of the ulcer

Two of the patients who had had gastro-enterostomy for duodenal ulcer were found to have carcinoma of the stomach on gastroscopic examination (Fig 4) In one instance the carcinoma involved the site of the anastomosis, and in the other the antral portion of the stomach In both cases the gastroscopic diagnosis of carcinoma was confirmed by exploratory operation

The final case in the group of gastro-enterostomy for duodenal ulcer was that of a tumor of the body of the stomach which gastroscopically appeared benign This was discovered 27 years following gastro-enterostomy Operation was advised and the tumor was removed successfully On microscopic examination the tumor was found to be a neurofibroma

#### OBSERVATIONS AFTER PARTIAL GASTRECTOMY FOR DUODENAL ULCER

The subsequent gastroscopic findings in all of the cases in which partial gastrectomy had been performed for duodenal ulcer are grouped in Table II also In 6 of the 19 cases in this group gastroscopic examination did not reveal any abnormality of the gastric or jejunal mucosa In this group not so much time had elapsed between the operation and the gastroscopic examination as in the cases in which gastro-enterostomy had been performed for duodenal ulcer The longest period of time to elapse in this group was 5 years In the 6 cases in which gastroscopy revealed nothing abnormal, we again found that the clinical history of gastric distress was extremely in-

definite but the functional element was pre dominant Again satisfactory results were obtained through medical measures

The most striking feature in the cases of partial gastrectomy for duodenal ulcer was the high incidence of erosive gastritis This condition occurred in 9 of the 19 cases At first glance, this high incidence of erosive gastritis might appear to constitute a contraindication to partial gastrectomy Such, however is not the case, for, as mentioned previously this form of gastritis in our hands has responded in a most satisfactory manner to adequate medical management In 2 of the cases of erosive gastritis, roentgenographic diagnosis of carcinoma had been made previously Because of this, operation was performed and at operation no evidence of carcinoma was discernible but extensive erosive gastritis was noted

In one case in this group a gastrojejunal ulcer was suspected, but this could not be identified positively on gastroscopic examination Roentgenographic examination of the stomach likewise failed to visualize the ulcer The patient was operated on at home, and we were informed by the surgeon that a gastrojejunal ulcer was present

There were three cases of gastritis following partial gastrectomy for duodenal ulcer As in cases of gastritis following gastro-enterostomy the response to medical management was not striking Two of the 19 patients in this group had undergone gastric surgery before partial gastrectomy had been performed Both had definite gastritis

#### OBSERVATIONS AFTER OPERATIONS FOR GASTRIC ULCER AND CARCINOMA

There were 11 cases in which operation had been performed for gastric ulcer (Table II) In this group were 8 patients who had undergone excision of the gastric ulcer and gastro-enterostomy and 3 who had undergone partial gastrectomy In 2 of the cases gastroscopy failed to reveal anything abnormal Similarly in 2 other cases, a gastroscopic diagnosis of carcinoma was made in 1 case 13 years after knife excision of the ulcer and gastro-enterostomy and in the other 17 years after partial gastrectomy Exploration was

not performed in either case after gastroscopy, so that there may be some question as to the accuracy of the diagnosis. We have been informed by the attending physician in the home locality, however, that the first patient has since died and that all the evidence pointed to carcinoma of the stomach as the cause of death. The other patient's attending physician has informed us that metastasis to the spine has developed. A diagnosis of gastric ulcer in addition to gastritis was made in 1 case. The patient was operated on and the ulcer demonstrated at operation. In the 6 remaining cases there was definite gastroscopic evidence of gastritis. In one of the 6 cases, roentgenoscopic diagnosis of gastric ulcer was made but could not be confirmed gastroscopically. The patient's symptoms were of such a nature that operation was not deemed advisable, so that the accuracy of the diagnosis was not established. In 2 of the 6 cases operations were carried out because of a history of bleeding, but nothing other than gastritis was noted in either case. In the 3 remaining cases, rather satisfactory immediate results were obtained from hospitalization and medical management.

From our limited experience, it is our impression that atrophic changes in the mucosa of the stomach are more likely to occur after partial gastrectomy than after gastro-enterostomy. Further study will be necessary, however, definitely to establish this point.

There were only 3 patients in the entire group of 100 who originally had been operated on for carcinoma of the stomach. Of these 3 (Table II) one was examined 3 months after operation and marked evidence of gastritis was found. This patient died some time later at home from what was thought to be recurrent carcinoma of the stomach. The second patient was examined 4 years after operation and found to have carcinoma involving the stoma. On exploration the lesion was found inoperable. The third patient was examined 10 years after operation and was gastroscopically normal. The patient has remained well.

#### MISCELLANEOUS OBSERVATIONS

Five cases which do not belong to any of the groups mentioned have been listed in

Table I under miscellaneous procedures and in Table II under miscellaneous procedures for duodenal ulcer and pyloroplasty for gastric ulcer. In this group are 2 cases in which knife excision of a duodenal ulcer and gastroduodenostomy were performed. In one of these cases gastric hemorrhages developed after operation. In spite of this, gastroscopy failed to reveal anything abnormal. Because of the bleeding, partial gastrectomy was performed, and at operation nothing was found on gross examination although microscopic examination of the tissue removed revealed gastritis and duodenitis. In spite of this operation, the patient continued to have gastric difficulty. The second patient was found to have erosive gastritis on both gastroscopic and roentgenoscopic examinations. This cleared up nicely after the patient had been hospitalized and placed on adequate medical management.

The 1 patient who had undergone pyloroplasty for gastric ulcer (Table I) had never secured satisfactory relief. Gastroscopy failed to reveal any adequate explanation for the continued gastric difficulty. In spite of extensive medical management, the patient continued to have trouble. The patient who had been subjected to pyloroplasty for duodenal ulcer continued to have gastric distress with additional gastric bleeding. On gastroscopic examination, extensive erosive gastritis was discovered. Partial gastrectomy was performed and the diagnosis of erosive gastritis was confirmed.

In the final case in Table I, the patient continued with gastric distress and bleeding after knife excision of the duodenal ulcer with reconstruction of the pylorus. On gastroscopic examination extensive gastritis was noted.

#### SUMMARY AND CONCLUSIONS

The gastroscopic findings in 100 cases in which previous operations had been performed on the stomach and in which gastric distress developed subsequently have been reviewed. From this review, we are of the opinion that gastroscopy can be of definite assistance in reaching a better understanding of the factors that may lead to gastric distress.

after operations on the stomach. Contrary to the commonly accepted teaching that gastritis is found in all stomachs after operation in 30 per cent of this series of cases of persistent dyspepsia gastroscopic evidence of disease was not present. As a rule in the cases in which abnormality of the gastric mucosa was not demonstrated by gastroscopy, the functional factor was found to be rather pronounced and in most instances the patients responded symptomatically to therapeutic measures directed to this end.

In 56 cases a diagnosis of gastritis of one type or another was made from the gastroscopic findings. In contrast to the cases in which gastroscopy revealed normal gastric mucosa, the response to medical management was not as satisfactory, and many of the patients required further operation. Postoperative gastritis may be thought to be simply a manifestation of gastritis that existed before operation. No doubt this is often true and many postoperative complications might be avoided if this possibility were always recognized before operation. On the other hand it is known that gastritis does develop after operation, and also that gastritis which is present before operation may disappear after operation. That gastritis undoubtedly does develop after operation is seen from the fact that evidence of gastritis was present in 56 per cent of the cases in our study. In comparison Swalm, Jackson, and Morrison found

gastritis in only 35 per cent of their routine gastroscopic examinations, and Schindler (3) reported an incidence of 41.8 per cent.

It is interesting to speculate as to the possible factors responsible for postoperative gastritis. No doubt in many cases a pre-existing gastritis is the responsible factor. In our opinion, a poorly placed stoma with inadequate drainage of the stomach is a very important factor and in addition, if the stoma retains an activity resembling that of a sphincter gastritis is not as likely to develop. Infection undoubtedly constitutes an important exciting factor.

Other lesions, such as gastrojejunal ulcer, carcinoma, gastric ulcer and benign tumor can and do develop in the stomach after operation, and gastroscopy may be of assistance in their proper recognition. In 5 cases in our series carcinoma of the stomach was found on gastroscopic examination and in 6 cases gastrojejunal ulcer was visualized.

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# CARCINOMA OF THE STOMACH

## Review of 444 Cases to Emphasize the Inadequacy of Present Methods for an Early Diagnosis

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**I**NVESTIGATION of cases of gastric carcinoma in which patients were admitted to a hospital in a large urban center reveals many interesting, if disturbing, facts. During the past two decades—1919 to 1938 inclusive—the medical and surgical wards of the Fourth Division of Bellevue Hospital admitted 444 patients with cancer of the stomach, of whom 31 were readmissions. Total admissions to Bellevue Hospital during this 20 year period were 1,040,784, indicating that about 0.17 per cent of the patients admitted suffered from cancer of the stomach.

During these two decades, a great many more gastric carcinoma cases were discharged than have been reported. It is certain that both by clinical and clerical errors, many discharges have been listed and filed under other diseases, i.e., bronchopneumonia, unknown disease, metastatic carcinoma primary no pathological, roentgenological or surgical proofs were found in the records of 40 patients discharged as gastric carcinoma, for which reason such data were omitted.

Since cancer of the stomach accounts for approximately one-third of the total deaths due to cancer in the United States, the problem of the end-results in these cases is extremely important. The dismal picture shown in our statistics illustrates the necessity of a more general approach to the problem. We feel that a statistical study of this group will give a more correct evaluation of the end-results in this type of carcinoma than the usually more optimistic surveys from clinics which tend to see selected cases from the country at large.

### OPERABILITY AND MORTALITY

Of the 444 cases of gastric carcinoma, 296, or two-thirds, were inoperable on admission,

and of these 36 patients were moribund, succumbing within 48 hours despite every effort to prolong their lives (Chart 1). Age, extreme cachexia, or a lesion deemed too extensive by clinical examination for removal caused 80 patients to be classified as "unjustifiable risks." Of these, 44, or 55 per cent, died while on the wards. In 105 cases there were evident metastases—by clinical examination—i.e., jaundice, enlarge cervical nodes, etc. Despite favorable clinical opinion, in 40 cases x-ray examination showed a lesion inoperable because of extent or location, and in 19 additional instances the x-ray showed metastases rendering operative cure impossible. In 52 cases operation was refused. In a number of cases the carcinoma was inoperable for more than one of the reasons mentioned.

After clinical and x-ray examination, 148, or  $33\frac{1}{3}$  per cent, of the patients were considered operable. Apparently some improvement in their condition could be hoped for after surgical intervention. However, even in this group, exploratory laparotomy in 69 cases proved that no further operative measure could be undertaken. Of these, 34, or 46.6 per cent, succumbed following operation.

In 55 cases palliative operations were performed: gastrostomy in 5, jejunostomy in 9, closure of perforation in 3, 1 secondary operation for recurrent carcinoma of the stomach following gastrectomy was attempted, but death resulted, gastro-enterostomy was performed in 37 cases. The particular palliative procedure selected made little difference in the fate of the patients, since we know that practically all of them died within a year. The only purpose of the operation was temporary relief of an obstructive lesion. Fourteen patients were reported as improved after gastro-enterostomy and discharged from the hos-

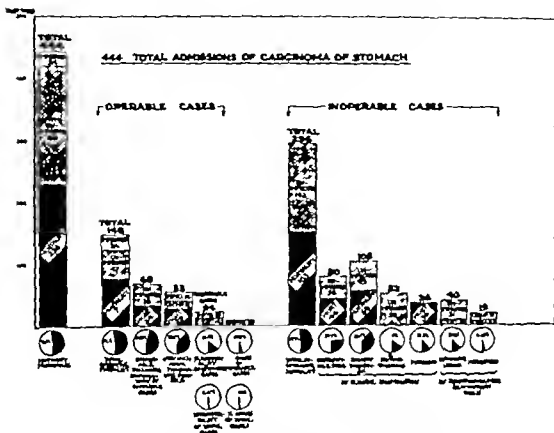


Chart Comparative results of operable and inoperable carcinoma.

pital as such but this improvement we know was a very temporary one.

In only 24 cases of the total of 444 was it possible to resect the carcinoma. In this group there were 14 deaths following the operation.

Our statistics show that only 24 cases of the total of 444, or 5.4 per cent of the total and 16.2 per cent of the 148 operable cases, could be subjected to gastric resection, the only hope for effecting a permanent cure in gastric carcinoma.

The mortality statistics indicate that deaths accounted for over half the cases in both the inoperable and the operable groups. Of the inoperable cases, 153 died without benefit of surgical intervention of the operable cases 77 were operative mortalities. These statistics reveal the low possibility of cure for the patient who enters a general hospital with car-

cino-ma of the stomach, and are probably a fair index of conditions in similar hospitals throughout the world. We realize that our percentage of resectability (5.4 per cent) is in no way comparable to figures reported by certain of our large clinics where cures of as many as 20 per cent of cases have been shown. These favorable reports from large and well known surgical centers are apparently the results of gastric resections in a carefully selected group of cases. The majority of such patients are referred to these centers by private physicians who have already chosen them as particularly favorable prospects for operation. The obviously inoperable cases never reach the large clinics. This factor of selection we feel accounts for the wide divergence in the statistical results which have been arrived at by these clinics and the general hospitals.

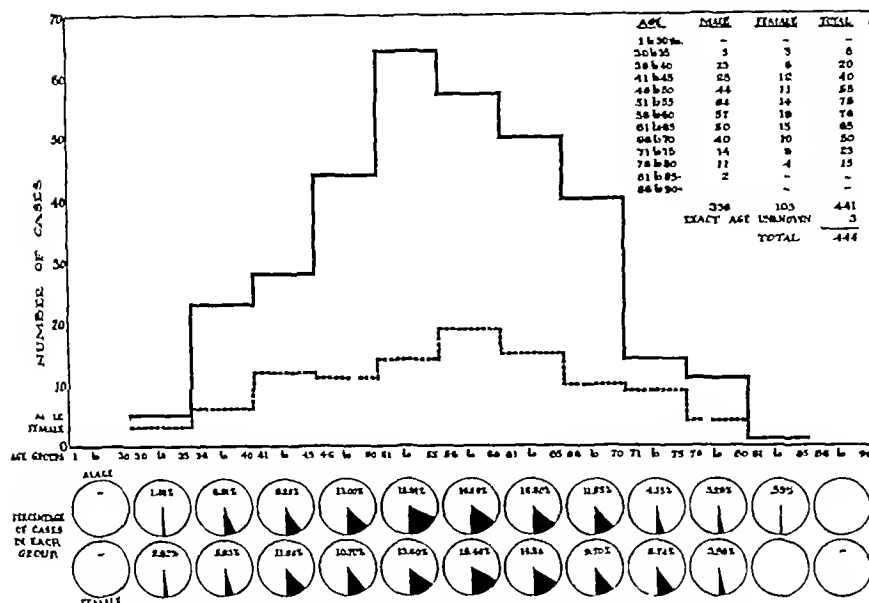


Chart 2 The incidence of male and female admissions, divided into age groups

## DIAGNOSIS

*Age and sex factors* In our series there were 341 cases in males and 103 in females, a ratio of approximately 3 to 1 (Chart 2). This great preponderance of males has been corroborated in many other reports. It is a well known fact (as seen from Chart 2) that the great majority of gastric carcinomas occur between the forty-fifth and sixty-fifth years. In our series the peak of incidence in males occurs between 51 and 55 years of age and that in females between 56 and 60 years of age. These findings concerning the preponderance in males and the incidence in later life are the two outstanding, unexplained factors in this condition. During that period of life when carcinoma most often occurs, there are marked changes in the content and nature of the sex hormones. This is evidenced by their chemical recovery from the blood and urine and by the involutionary changes which take place during this period. An effort to correlate these facts is being attempted in a further publication.

*Symptomatology* The presenting symptoms in those patients admitted to our wards with gastric carcinoma are pain, 92.8 per cent, loss of weight, 89.6 per cent, weakness, 60.5 per

cent, and cachexia, 43.7 per cent, jaundice, 23.2 per cent, nausea and vomiting, 16.3 per cent, and hematemesis, 9.2 per cent. It is evident that jaundice is a late and unfavorable symptom. However, the great majority of cases in which jaundice had not occurred, could not be considered as favorable, since even though they received prompt attention (clinical, diagnostic, and surgical) they often proved inoperable (Chart 3). 66⅓ per cent, 296 cases presenting these symptoms, proved inoperable, 83.5 per cent, or 124 of those considered favorable prior to operation, were found by exploration to be inoperable or subject only to palliative operation.

Perhaps even more significant is our finding that the duration of symptoms had practically no relationship to the resectability or operability of the lesion. From Chart 3, it is clear that approximately the same percentage of inoperable cases were discovered in the group in which symptoms had been present for 1 month or less, as in groups in which symptoms had been present for a year or more. Apparently, our closely held belief, that cases in which the symptomatology is recent in development hold a better prognosis, is in gastric carcinoma, at least, nothing more than a



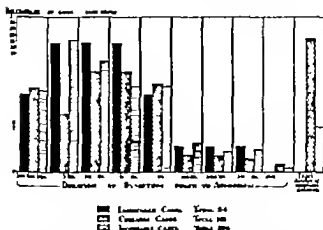


Chart 3. The relationship of the duration of symptoms in the resectable, operable and inoperable groups as indicated by percentages

shibboleth. No matter how long symptoms have been present, our statistics show a startling similarity of the percentage possibility of improvement by operation (Chart 3).

It is enlightening to note that in the groups in which the duration of symptoms was less than 3 months both the percentage of resectable and the percentage of operable cases were smaller than the percentage of inoperable cases. Presumably a cancer so malignant as to produce troublesome symptoms in so short a time progresses too rapidly to be operable. It is obvious that our criteria for diagnosis of gastric carcinoma are faulty and that the symptomatology we depend upon is unreliable for early diagnosis. If we wait for these evidences, we are allowing the patient to pass the stage at which complete surgical removal with possible cure can be offered. Our present accomplishment is that of making a determined effort to diagnose the late cases.

**Peptic ulcer.** In 55 of our cases, a clinical diagnosis of ulcer had been made, and in 21 additional cases it was reported after x ray examination. In the 368 cases remaining there was no evidence in the clinical history, the report of the physician, or the x ray examination that a diagnosis of peptic ulcer had ever been suggested.

We had only 17.1 per cent of cases in which a malignant degeneration of peptic ulcer could be considered as possible. Many authors have considered this change as likely

(1, 3, 6, 11, 12, 17, 19). Smithies and Ochsmier (17) in a résumé of 566 cases, reported that 239 or 41.8 per cent fell into the cancer following ulcer category. Early gastric carcinomas may appear in their early stages as small ulcerative lesions on roentgenological examination. During this period, they may give every sign and symptom of gastric ulcer—they are gastric ulcers at this stage. However, there is no proof on examination either of operative or autopsy material as shown by Ewing (5) that these malignant ulcers had their inception as benign ulcerative lesions. Their malignancy becomes apparent upon further involvement of the stomach and its adjacent organs or upon the appearance of distant metastases.

The more frequent use of the gastroscope has shown that gastric malignancy occurs on mucosa which is already the seat of a chronic pathological alteration (2, 4, 13, 16). However, this lesion so far as we have been able to ascertain is not a peptic ulcer.

Gastric ulcer and gastric carcinoma have entirely individual and clearly typical clinical and pathological manifestations which bear little relationship to each other. Both lesions are of fairly common occurrence and it is therefore not surprising that in some cases they may be found concomitantly. Such coincidences are not proof that one condition has developed as a result of the other. It is conceivable that these two entities may be

linked by etiological relationship." A review based on experimental work on the effects of hormones on the gastric mucosa and the pathological states which they institute will be published at a later date. As yet, there is little proof established that malignant ulceration has originally been benign. In a previous report (7) from our clinic we found on studying 104 gastric ulcers and 118 gastric carcinomas, that 9 ulcer cases were suggestive of carcinoma, and immediate operation was advised. One refused and 8 were operated upon. Six of the eight were proved histologically to be benign. In over 1,000 cases of peptic ulcer followed from 1 to 12 years, we have not observed this transformation to take place. From our clinical experience in observing gastric ulcers, we feel that the indication for immediate operation as a means of preventing malignant degeneration is seldom present.

**X-ray diagnosis.** A gastro-intestinal series of x-ray diagnosis was carried out in 265 of our series of 444 cases. A number of patients were unsatisfactory subjects because their moribund condition, vomiting, hematemesis, etc. made them too ill for this type of examination.

Of the 265 cases in which x-ray was done, 237 showed roentgenological evidence of carcinoma of the stomach. The 28 remaining were reported as negative for gastric carcinoma, but laparotomy proved the existence of the lesion.

By arbitrarily dividing the cases into 4 groups, according to the extent and locality of the lesion, it was found that 74, or 28 per cent, were located unfavorably for radical resection. One hundred thirty-three cases showed roentgenological evidence of carcinoma involving more than a single portion of the stomach and were unfavorable because of the extent of the lesion.

In group 1, 12 showed involvement of the esophagus by extension, 44 in the cardia, and 3 in the fundus. In group 4, the lesion was shown to be large and extensive, in each case involving more than one-half of the stomach. These (groups 1 and 4) were obviously unfavorable subjects for extirpation of the entire lesion. The 2 remaining groups—2 in which the lesser or greater curvature or media was

involved and 3 in which the pylorus was the seat of the lesion—were considered more hopeful. Another complicating factor was that the lesion had not remained localized in the affected site but had advanced beyond it. In 56 cases, 22.2 per cent, the carcinoma involved both sites mentioned in groups 1 and 2. Thus the favorable outlook was considerably lessened.

**Gastric analysis.** Gastric analysis was performed in 70 of our cases, of whom 60 showed absence or diminution of free hydrochloric acid. In 46 cases blood was present.

Because of its simplicity, the gastric test meal should be carried out as a routine procedure among patients in the so called cancer period. In patients with achlorhydria, x-ray examinations should be repeated often to enable recognition of the earliest possible sign of change.

Certainly one cannot generalize that all patients with achlorhydria and achylia fall into the classification of gastric carcinoma, but such findings ought to stimulate a suspicious attitude. The strong possibility of cancer is to be kept in mind until roentgenological or gastroscopic examination definitely excludes it.

In every patient with vague abdominal complaints who has passed his thirty-fifth year, and in whom a diagnosis is not obvious, gastric malignancy must be ruled out. The most dependable means at our disposal for this purpose are the gastric test meal, the fluoroscopic and x-ray examination, and gastroscopy. The x-ray evidence has already been indicated for this series. However, it is noted that x-ray films are taken too infrequently and are not repeated. The physician has often been limited in his examination of the patient because of the expense of the procedure (although this expense could and should be materially reduced).

**Gastroscopy.** The advent of the flexible gastroscope has widened the diagnostic possibilities in gastric carcinoma. At present many well trained men are perfecting this technique so that it may become available as a deciding factor in disputed and undiagnosed cases. When a decision is obscure following clinical, roentgenological and laboratory studies, the

patient should have the benefit of a gastroscopic examination.

#### SUMMARY AND CONCLUSIONS

1 The outlook in gastric carcinoma is at the present time a very dismal one, since the largest number of patients in whom the diagnosis is made are already in an inoperable stage. Often when operability still exists, resectability is impossible. The percentage of successful cures in a general hospital remains very small.

2 Large surgical centers are enabled to show a better result because of preliminary selection of cases by the referring physician.

3 The most dependable confirmations of diagnosis are the x-ray, the gastroscope and the gastric test meal. The latter is the simplest and may be repeated at frequent intervals at relatively little expense. When examination shows a declining gastric acidity, the suspicion of carcinoma must be entertained and disproved.

4. Roentgenological studies of the stomach should be made with greater frequency. The physician must arrange with roentgenologists for lowered cost of this procedure so that such examination may be done repeatedly in suspicious cases and in those comprising the large group with undiagnosed and vague manifestations. A ray of these patients is necessary not to verify an already made clinical diagnosis, but for careful search where there is no evidence or only minimal evidence of gastric pathology.

5 The technique of gastric resection has been perfected in the hands of those who have the opportunity of performing this operation frequently. Further operative refinements cannot offer hope for lengthening the life span of gastric carcinoma patients. Their hope resides in the development of a means of diagnosis which will permit surgical intervention when the lesion is pathologically young rather than early in the clinical course.

6 Several authors (7, 10, 14, 15, 18) have pointed out that certain gastric malignancies are radiosensitive and have suggested combined forms of therapy. However this is admittedly merely palliative. Levin has tried roentgen therapy in a number of cases and

discarded the method completely although he still believes in the insertion of radon into inoperable growths at operation. Radiotherapeutic methods in the treatment of gastric carcinoma may be envisioned but this possibility offers little immediate hope.

7 The knowledge of the present dark outlook of the patient with carcinoma of the stomach should be disseminated among all practitioners and students of medicine. Until more specific tests are developed, each patient should have the benefit of such methods as are at our disposal. Faithful use of the test meal, the x ray and the gastroscope may help us to disclose early carcinomatous lesions.

8 Experimental and investigative endeavors to explain the sex linkage and age incidence in gastric carcinoma should be attempted. In view of recent biochemical and physiological discoveries, a new field is opened to those who are studying the etiology of carcinoma.

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# ESCHWEILER DANGERS OF INSULIN AFTER GLUCOSE INFUSION

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## DANGERS OF THE INDISCRIMINATE COVERAGE OF PARENTERALLY ADMINISTERED GLUCOSE WITH INSULIN

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THE "routine" administration of insulin during intravenous infusion of solutions of glucose is often fraught with danger. Too often there is complete disregard of the patient's intrinsic mechanism of carbohydrate utilization and of the potential stimulating effect of the glucose alone on this mechanism. Most physicians advocate that whenever a patient with diabetes mellitus complicated by a surgical or obstetrical condition is given an infusion of 500 cubic centimeters of 10 per cent glucose, 25 units of regular insulin should be administered to "cover" the glucose as a routine measure. This teaching has led to the impression that the status of the diabetes can be disregarded because the action of the insulin is nullified by the parenterally administered glucose.

The fact that all patients with diabetes mellitus cannot tolerate the same amount of insulin with an infusion of glucose without suffering hypoglycemic reactions was made evident by 2 cases which were presented at medical conferences during the past year. Two patients with moderate diabetes mellitus had severe hypoglycemic reactions following glucose infusions "covered" by insulin administered subcutaneously. One, a female aged 48 years who was known to have had diabetes for 8 years, had not strictly adhered

to the prescribed diet and had been given insulin at various periods. The patient was admitted to the hospital with a history indicative of cholecystic disease, which was later confirmed by roentgenogram and laparotomy. Before operation was performed good control of carbohydrate metabolism was obtained by a prescribed diet of 170 grams of carbohydrate, 75 grams of protein and 50 grams of fat without insulin. The operation was done under gas-oxygen-ether anesthesia. Following operation 700 cubic centimeters of 10 per cent glucose was administered intravenously accompanied by 35 units of regular insulin which was injected subcutaneously. Within 2 hours marked manifestations of hypoglycemia occurred. The condition resembled postoperative or anesthesia collapse with respiratory center depression.

The second patient was a gravid female, aged 30 years, who was known to have had diabetes for 6 months. The condition had been well controlled by means of a diet of 190 grams of carbohydrate, 79 grams of protein, and 45 grams of fat with 15 units of regular insulin a day. She was admitted to the hospital near term for an elective cesarean section. As a pre-operative "routine" procedure 1000 cubic centimeters of 10 per cent glucose was given intravenously and 50 units of regular insulin subcutaneously. After operation hypoglycemia was evidenced by convulsions, characterized by a decerebrate attitude. The

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blood sugar taken at this time was below 10 milligrams per 100 cubic centimeters of blood.

The untoward responses in both cases indicate that there is a real danger of a severe insulin reaction in patients with mild or moderate diabetes mellitus who receive infusions of glucose covered by regular insulin. Prompted by these observations 5 patients with diabetes mellitus in various degrees of severity were given infusions of 500 cubic centimeters of 10 per cent glucose in saline solution *without insulin*. One additional patient, a non-diabetic, served as a control. The blood sugar curves of each were plotted. Four of the patients had been admitted to the hospital for infections of the feet which healed under conservative treatment. 1 had been admitted for dietary and insulin adjustment. The diet for all 5 patients had been moderately high in carbohydrates (160 to 220 grams) and low in fats (45 to 57 grams) and proteins (76 to 82 grams) for at least 2 weeks before the glucose infusion was administered. The patients were not allowed to eat breakfast before the intravenous glucose tolerance test was made and in each case any prescribed insulin was omitted (No member of the group was receiving protamine insulin). An infusion of 10 per cent glucose in saline solution was given to each patient at a constant rate of flow so that 500 cubic centimeters was administered in 30 minutes. Determinations were made before and during the administration of the glucose and samples were taken for each patient at the close of the 30 minute period and every 30 minutes thereafter. All of the determinations of blood sugar were made by the same technician who employed the modified Benedict's micro-chemical method (9). The results of the determinations are charted in Figure 1.

It will be observed that the most severe case of diabetes mellitus represented by curve I had a fasting blood sugar of 425 milligrams per 100 cubic centimeters of blood. At the close of the 30 minute period of infusion it rose to 800 milligrams. Within 1½ hours after completion of the infusion the blood sugar dropped to within 100 milligrams of the fasting level. The mildest case (curve V) had a fasting blood sugar of 140 milligrams. The

blood sugar rose to 425 and returned to within 10 milligrams of the fasting level in 1½ hours and dropped to 100 milligrams or 40 below the fasting level in 3½ hours. At the completion of the infusion all the curves show a sharp break and then with the exception of curve VI, have a similar downward trend, the values depending on the height of the fasting level. Characteristically curves I, II, III and IV which represent the more severe cases of diabetes do not descend as abruptly as curve VI which represents the case without diabetes. As expected, the patient with mild diabetes (curve V) tends to approach the levels of the non-diabetic. This analysis, therefore, would indicate that following an infusion of 500 cubic centimeters of 10 per cent glucose even a patient with severe diabetes mellitus does not require regular insulin to return the blood sugar values near to the fasting level.

#### REVIEW OF THE LITERATURE

McKittrick and Root and many other writers have studied the management of patients with diabetes mellitus complicated by surgical or obstetrical conditions, the diet prescription, and use of insulin glucose infusions, physiological saline or Ringer's solution for dehydration or R lactate for acidosis. However I have been unable to find in the literature any previous report of blood sugar response following glucose infusions or the danger of routine use of insulin to cover glucose administered parenterally.

The danger of hypoglycemia, especially in individuals with arteriosclerosis, has been excellently studied by Middleton and Ostway and by many other writers. Deaths due directly to insulin reactions have been reported (3).

The intravenous injection of glucose increases carbohydrate utilization. The increase is probably due to stimulation of endogenous insulin production or depression of the anti insulin factor of the pituitary gland. Depisch and Hasenochel have shown that intravenous injection of glucose in non-diabetic subjects produces a hyperglycemia followed by hypoglycemia. It is also demonstrated in this study by the drop in blood

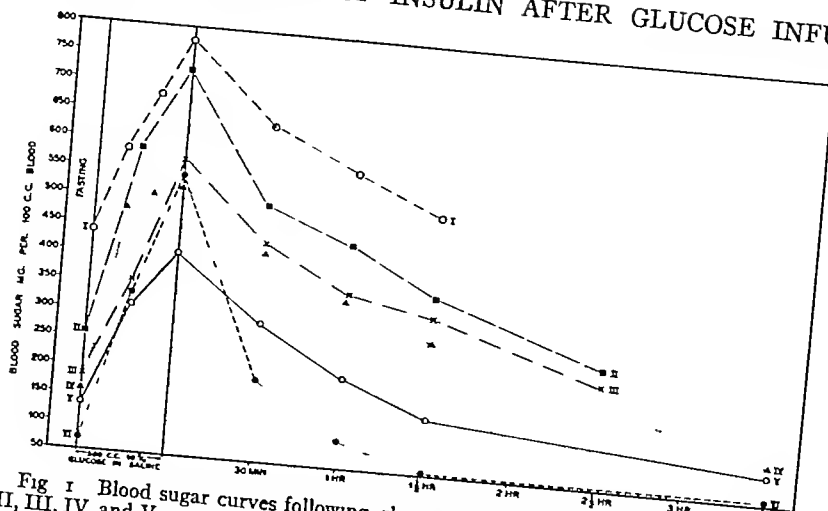


Fig 1 Blood sugar curves following glucose infusion without insulin. Curves I, II, III, IV, and V represent patients known to have diabetes mellitus. Curve VI represents a patient without diabetes mellitus. Blood sugar levels approximate their usual fasting levels in 1 1/2 to 2 hours after infusion and sink to the fasting levels or lower within 3 1/2 hours.

sugar below the fasting level in curves V and VI. Weber and Hausler believe that the drop to a value below the fasting level is due to an increased secretion of insulin. In their experiments they found that the blood sugar level ultimately sinks lower in normal subjects injected with regular insulin administered subcutaneously with an intravenous injection of glucose than in the same subjects given an equal amount of insulin and *no glucose*. These findings are in keeping with the work of Staub and Traugott who independently determined the effect of glucose and non-diabetics. The glucose was administered in single doses and in 2 doses divided by a lapse of time. A single dose of glucose given orally to a non-diabetic at first caused an elevation of the blood sugar level. It then began to drop and within 2 hours after the administration of the glucose the blood sugar was below the fasting level. A second dose given during the descent of the curve either caused only a slight elevation of the blood sugar level or none at all in the patient without diabetes. In a patient with diabetes mellitus the second dose caused a further rise in the blood sugar. Individuals with diabetes lose in varying degree the ability to respond with insulin production to stimulation by carbohydrates. The amount of the rise in blood sugar follow-

ing the second dose in the patient with diabetes mellitus varies inversely with the degree to which the individual's glucose utilization mechanism is stimulated. The milder the diabetes, the more nearly does the response approach that of the non-diabetic patient. "Insulin-like" reactions may occur with blood sugar values over 200 milligrams per 100 cubic centimeters of blood. Reactions from regular insulin given subcutaneously in these unusual cases are evidently due to rapid drop of blood sugar, that is, a patient with a blood sugar of 350 milligrams which suddenly drops to 200 milligrams following regular insulin administration may go into shock (24). A plea to individualize the treatment of patients with diabetes mellitus will bear emphasis. The great variation in the diabetic status is evident when the definition of true diabetes mellitus as given by Joslin is considered. First, any patient who has glycosuria demonstrable by any of the common laboratory tests is considered to have diabetes mellitus until the contrary is proved. Second, any patient with a fasting blood sugar above 140 milligrams per 100 cubic centimeters of blood on an unrestricted diet, or 170 milligrams or more after a meal with a simultaneous glycosuria plainly related to diet, is a true diabetic. Obviously many patients with diabetes mellitus present only have mild cases and closely

approach the normal. The fasting blood sugar levels range from these lower limits to over 500 milligrams per 100 cubic centimeters of blood with or without fasting glycosuria. The range of the fasting levels of the blood sugars is demonstrated in this study (Fig 1 curves I II III IV and V).

Not only is the severity of diabetes mellitus an important factor to be considered before the administration of glucose with insulin, but also the fact that the patient's ability to utilize carbohydrates varies at different times during the day. An excellent example of this is the blood sugar changes, studied by Barach, that occurred in a patient with diabetes mellitus after he had had breakfast. The patient was a 57 year old male known to have had diabetes for 2 months. He had been on a diet of 200 grams of carbohydrate, 70 grams of protein, and 85 grams of fat without insulin for the 8 days prior to the day blood sugar determinations were made at hourly intervals. Fasting blood sugar was 200 milligrams per 100 cubic centimeters of blood. This rose to 300 milligrams 2 hours after breakfast and in 1 hour dropped to 120 milligrams, a sudden drop in his blood sugar of 180 milligrams in 1 hour without parenterally administered insulin. Fluctuations in blood sugar levels are found particularly in the child with diabetes and also at the other end of life when arteriosclerosis is common.

It is frequently impossible to individualize the treatment of a patient with diabetes mellitus when the patient is being admitted for emergency surgery. A case of mild diabetes frequently has a pre-operative glycosuria of 2 to 3 per cent with a blood sugar level of 190 to 250 milligrams per 100 cubic centimeters of blood. Such findings would lead one to believe that the patient had severe diabetes mellitus and would therefore tolerate large doses of regular insulin. These patients of unknown status run the grave danger of insulin reactions when an infusion of glucose is arbitrarily covered with regular insulin.

To make the statement that 1 unit of regular insulin will metabolize 2 grams of glucose is to invite trouble. Joslin says: "It is dangerous to prescribe insulin in arbitrary or schematic fashion. In general the method of

trial and error should be adapted always erring on the side of low and frequent rather than high and single dosage. In general 1 unit of insulin will metabolize 1 to 2 grams of carbohydrate and perhaps even 3 to 6 grams. Newburgh says that 1 unit of regular insulin will metabolize 7 grams of carbohydrate and Holm makes the statement that 8.75 grams of carbohydrate are metabolized by each unit of regular insulin.

A factor of extreme importance is the degree of sensitivity to insulin, and this must ever remain an unknown variable. Himsworth has demonstrated that different cases of diabetes mellitus given equivalent amounts of regular insulin intravenously and glucose orally register marked differences in blood sugar responses.

#### SUMMARY

A usual pre-operative or postoperative procedure is to give an infusion of 500 cubic centimeters of 10 per cent glucose covered by 25 units of insulin in cases of diabetes mellitus complicated by obstetrical or surgical conditions. Too frequently a hypoglycemic reaction results. Therefore a study has been made to determine whether all patients with diabetes mellitus can be expected to tolerate the same amount of insulin with an infusion of glucose. Intravenous glucose tolerance tests were given to 5 patients with diabetes mellitus of various stages of severity and to 1 normal patient. It was determined that insulin is not required to reduce the blood sugar values near to the fasting level after the intravenous administration of 500 cubic centimeters of 10 per cent glucose, as the blood sugars of the patients with diabetes mellitus reached blood sugar levels approximating their usual fasting levels within  $1\frac{1}{2}$  to 2 hours. It was demonstrated that the milder the case of diabetes the more nearly was approached the curve representing the non-diabetic patient. It may be concluded, therefore that insulin should never be routinely administered to cover parenterally administered glucose in patients with diabetes mellitus. The diabetic status of the patients must be taken into consideration and thus dangerous hypoglycemic reactions may be avoided.

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## RENAL DISPLACEMENT

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**I**n this study we have attempted to correlate the various findings of renal displacement by the adjacent organs and of the reverse namely the displacement of the adjacent organs by the kidney in diseased states. The findings presented are based on the actual conditions found by x ray and in most instances proved by operation or autopsy. This study was divided into two parts (1) The displacement of the kidney by the adjacent organs, and (2) the displacement of the adjacent organs by the kidney.

While proceeding with this work every organ adjacent to the kidneys was studied and observations were made as to its influence in displacing the kidney in varied pathological states.

### RENAL DISPLACEMENT BY THE ADJACENT ORGANS

The kidney like any other organ may be displaced from its original bed by the encroaching massive pressure of a neighboring structure. This displacement, however does not occur always and is apparently limited by certain anatomical factors. One mass may displace it, while another in the same position will not dislodge it from its bed.

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**Liver** It is surprising that the liver with its bulk in massive enlargement does not displace the kidney. We observed no displacement in hepatomegaly, huge carcinomatous tumor and large hydatid cysts (Fig. 1).

**Spleen** The spleen may and may not displace the kidney. If the splenic mass becomes enlarged in all directions like in splenic infarct or lues, it will always displace the kidney downward and inward bringing it to lie on top of the transverse processes of the vertebrae. If however the spleen enlarges downward only that is, intraperitoneally displacement is absent or may be very slight (Fig. 2).

**Pancreas** Recently Kretschmer<sup>1</sup> reported a rare case of a large pancreatic cyst proved by operation. There was a very notable displacement of the kidney downward and outward (Fig. 3d).

**Retroperitoneal tumor** Every retroperitoneal tumor will displace the kidney moderately at first and very markedly as the size of the tumor increases. The kidney can be displaced medially downward upward and outward depending upon the location of the tumor either laterally above or below the kidney. If the tumor is a solid unattached fibrosarcoma below the kidney it will dislodge and rotate it with the calyces pointing straight upward (Fig. 3).

May, 1932, 4 Obst. 224, 69, 871



Fig. 1, a, Hepatomegaly; b, carcinoma of liver; c, hydatid cyst of liver

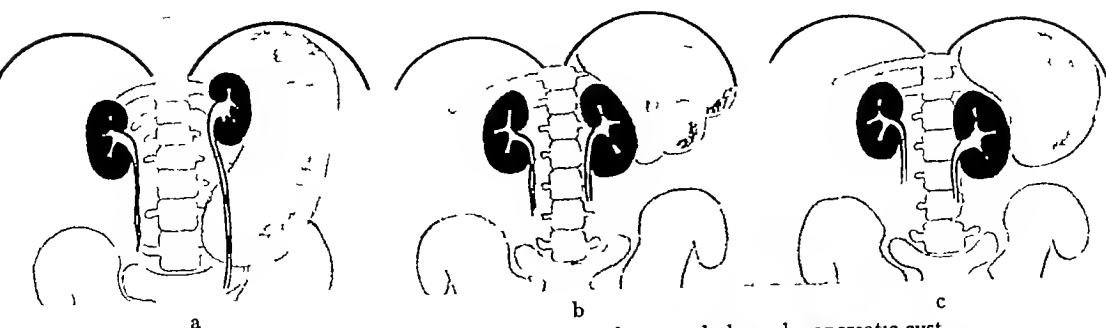


Fig 2 a, Splenomegaly, b, splenic infarct, c, splenomegaly lues, d, pancreatic cyst

*Subdiaphragmatic abscess* A subdiaphragmatic abscess, especially when large, will definitely displace the kidney downward and may also rotate it outward (Fig 4)

*Perinephritic abscess* There is no renal displacement in perinephritic abscess, no matter where the abscess is located. The kidney, however, will become permanently displaced and fixed in one position after the surgical drainage and the resulting inflammatory adhesions of the retroperitoneal space. It has lost its mobility and remains fixed in a mass of hard scar (Fig 4)

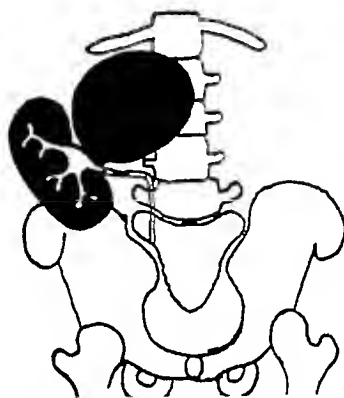


Fig 2d

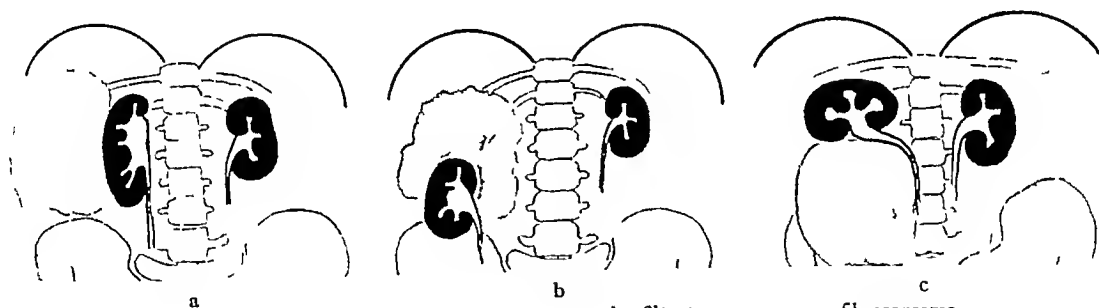


Fig 3 a, Retroperitoneal tumor, b, retroperitoneal infiltrating sarcoma, c, fibrosarcoma

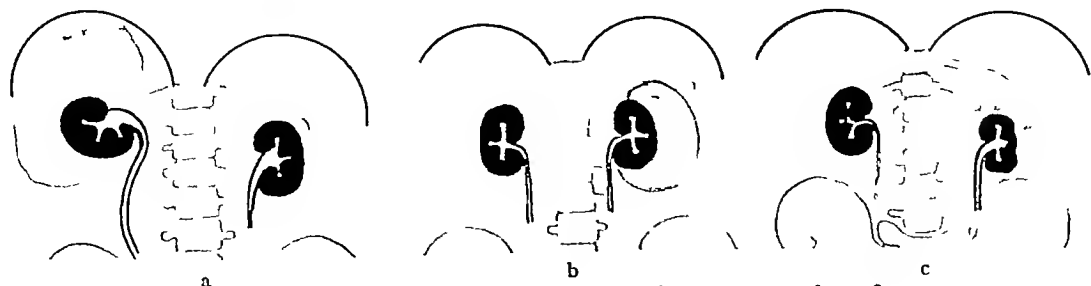


Fig 4 a, Subdiaphragmatic abscess, b, perinephritic abscess, c, perinephritic fixation.



Fig. 5 Diverticulitis plus abscess of ascending colon.

*Ascending and descending colon* The colon will not displace the kidney, no matter how much dilated it has become. Even massive carcinomatosis will remain without influence upon the kidney. In massive diverticulitis with large abscess formation, no renal displacement was noted (Fig. 5).

*Adrenal* If the adrenal tumor is large it will invariably displace the kidney downward. The kidney remains uninfluenced by small tumors (Fig. 6).

*Pelvic organs* There is no renal displacement by the massive growth of any of the pelvic organs. Large ovarian cysts or huge uterus in pregnancy do not displace the kidney (Fig. 6).

*Spine* In scoliosis of the spine the kidney may be rotated and swung outward and may be ptoed (Fig. 6).

#### SUMMARY

The kidney can be displaced by the spleen, retroperitoneal tumor, subdiaphragmatic abscess, the adrenal, the spine, and by perinephritic adhesions. It will not be displaced by the liver, perinephric abscess, ascending colon, descending colon or pelvic organs.

#### DISPLACEMENT BY KIDNEY OF ADJACENT ORGANS

*Liver* The liver is not displaced by any renal pathological process. It could only be affected by a tumor or cyst of the upper pole. Our studies of such films failed to show any displacement (Fig. 8).

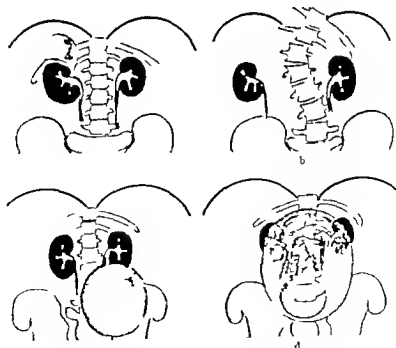


Fig. 6 a, Adrenal tumor, b, scoliosis, c, ovarian cyst, d, pregnancy

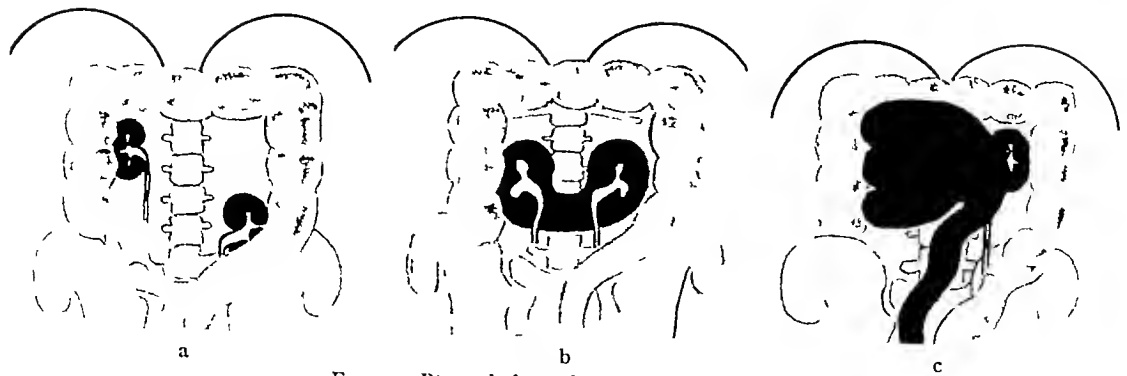


Fig 7, a, Ptoxis, b, horseshoe, c, hydronephrosis

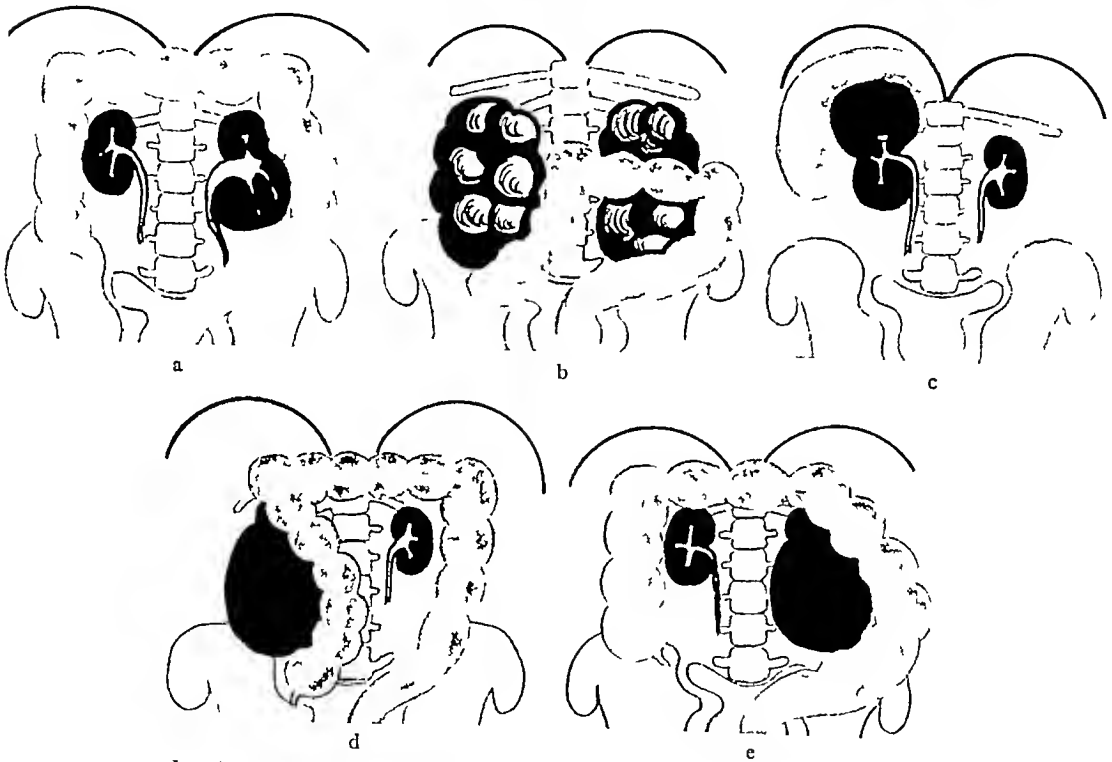


Fig 8 a, Tumor, b, polycystic kidneys, c, cyst of upper pole, d, cyst of right lower pole, e, cyst of left lower pole

**Spleen** The spleen is not displaced by the kidney in any pathological condition of tumor or cyst of its upper pole

**Ascending and descending colon** Both the ascending and descending colon are markedly displaced by bilateral polycystic kidneys. The ascending colon is pushed inward and forward, while the descending colon is displaced out-

ward and forward. This has been observed in all cases with true polycystic disease. A tumor of the lower pole, either hypernephroma or cyst, will displace the ascending or descending colon depending upon which side is affected. The colon is not displaced in horseshoe kidney, in renal ptosis, nor in huge hydronephrosis (Figs 7 and 8)



Fig. 5. Diverticulitis plus abscess of ascending colon.

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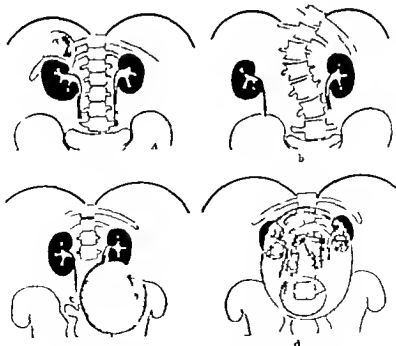


Fig. 6 a, Adrenal tumor b, scoliosis c, renal cyst d, pregnancy

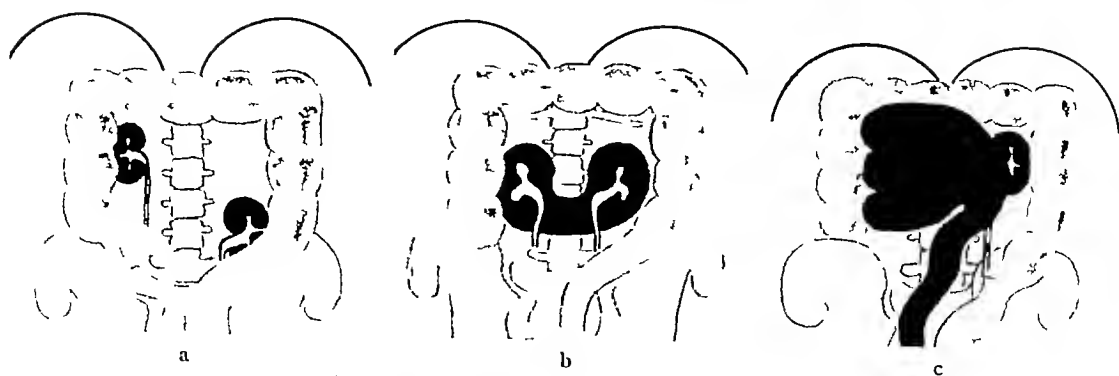


Fig 7, a, Ptois, b, horseshoe, c, hydronephrosis

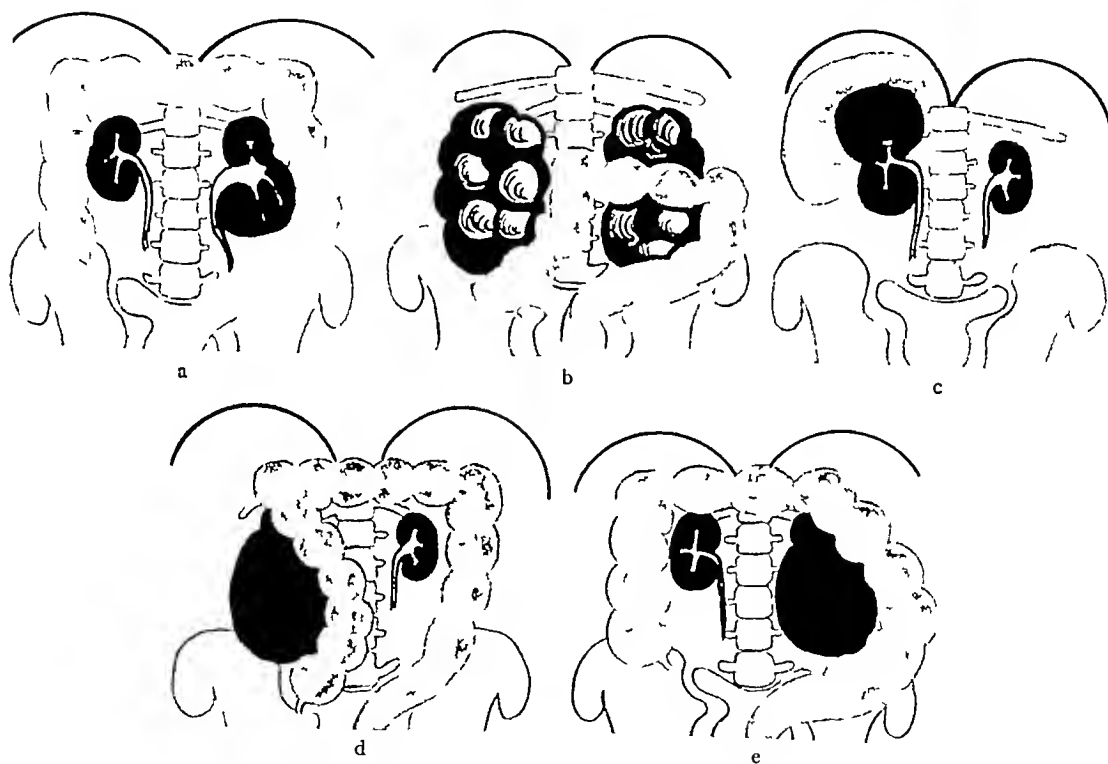


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**Spleen** The spleen is not displaced by the kidney in any pathological condition of tumor or cyst of its upper pole

**Ascending and descending colon** Both the ascending and descending colon are markedly displaced by bilateral polycystic kidneys. The ascending colon is pushed inward and forward, while the descending colon is displaced out-

ward and forward. This has been observed in all cases with true polycystic disease. A tumor or cyst, will displace the ascending or descending colon depending upon which side is affected. The colon is not displaced in horseshoe kidney, in renal ptosis, nor in huge hydronephrosis (Figs 7 and 8)

*Adrenal* An upper polar tumor of the kidney will always displace the adrenal in its upward growth pushing it inward.

#### SUMMARY

The kidney will displace the ascending and descending colon and the adrenals only. It will not displace the liver or spleen.

#### EVALUATION OF STUDY

This study brings out some very interesting points. It shows that while the spleen invariably displaces the kidney the liver (an organ similarly situated and much bulkier) will not do it while a subdiaphragmatic abscess will dislodge the kidney a perinephric abscess will not. A true retroperitoneal tumor will always cause displacement. The kidney

on the other hand can displace only the colon and adrenal not the spleen nor liver.

#### Kidney not displaced by

Liver  
Perinephric abscess  
Ascending colon  
Descending colon  
Pelvic organs

#### Kidney does displace

Ascending colon  
Descending colon  
Adrenal

#### Kidney displaced by

Spleen  
Perinephric adhesions  
Subdiaphragmatic abscess  
Adrenal  
Spine

#### Kidney if not displaced

Liver  
Spleen

The facts brought out in this study are of value for the differential diagnosis of tumor masses in the abdomen by limiting the possibility of renal displacement to only a few instances.

We want to thank Drs. E. P. Prodergram and P. Hodges for their co-operation.

# EXPERIMENTAL STUDY OF THE SURGICAL TREATMENT OF CORONARY DISEASE

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CARDIAC surgery, proceeding carefully and methodically, has already accomplished much for the relief of coronary disease. The earliest operations were upon the sympathetic nervous system and were designed to relieve the pain of angina pectoris through interruption of the nervous pathways. Later attempts were made to increase the blood supply of ischemic myocardium by grafting onto the heart, from which it was hoped collateral circulation would be supplied. These operations, devised respectively by Beck and O'Shaughnessy, were based upon extensive experimental work and have already proved their value in human subjects.

The work of Leriche and his associates on vascular diseases of the extremities, especially partial arteriectomy, suggested one of the modes of attack here to be described. In their opinion the resection of a major arterial trunk gave on its most important objective the interruption of vasoconstrictive pathways. Their experimental studies and their results in human beings seem to substantiate that such a procedure almost invariably brings about vasodilatation and thus improves considerably the blood supply to the ischemic area. So impressed was Leriche with the beneficial and permanent results of partial arteriectomy in the extremities that he went so far as to suggest it as a worth-while procedure in coronary disease.

At the same time the value of venous ligation as an aid to the development of a collateral circulation has been emphasized by many workers. In 1913, Oppel demonstrated the efficacy of ligating the popliteal vein in the treatment of senile gangrene of the foot. In 6 cases thus treated the extremities recovered not only their warmth and color without the development of edema, but also a certain

degree of hyperemia of the feet and toes. Four years later, as a result of the experimental work of Van Kead and the reports of Makins, Schrt, Propping, and Tuffier it could be stated as one of the fundamental principles in vascular surgery that the companion vein must always be ligated with the artery. This combined procedure according to Makins brings about its beneficial effect by maintaining within the limb for a longer period the smaller amount of blood supplied by the collateral arterial circulation. These findings were confirmed by Brooks and his co-workers and by Holman and his associates. Pearse, and Pearse and Morton have shown that this procedure realizes (a) an increase in the residual arterial pressure, (b) an increase in the venous pressure, (c) an increase in minute flow from end of divided artery, (d) an increase in the peripheral arterial circulatory bed.

The following experiments were undertaken in order to observe the effect of these two procedures: (a) partial coronary resection and (b) partial coronary resection combined with ligation of the accompanying vein.

## EXPERIMENTS

*Group 1* Partial resection of the ramus descendens. Fifteen dogs were used in this series. Under positive pressure ether anesthesia, the heart was exposed and the pericardium opened. In each case the ramus descendens was isolated near its origin with the least possible trauma and from one to one and a half centimeters of its length resected. Great care was taken to avoid injuring any of the branches emerging from this main trunk. Immediately after the resection, 6 animals developed arrhythmias and died at once from ventricular fibrillation. Three more died within 2 to 3 hours, probably from the same cause. Of the 6 remaining, 2 lived for 24 hours, 3 for 48 hours, 1 lived for approximately a year and died with signs of cardiac

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Fig. The anterior half of cross section of the heart 4 centimeters from the lower end. At the lower left, part of the left atrium is the center the septum, at the right, the wall of the right ventricle. The anterior part of the heart, lying over the septum and extending to the right and to the left, is made up of loose scar tissue covered with the two layers of the pericardium. At the upper left is part of the lung which is adherent to the heart.

failure. At the autopsy it was found that the resection had been performed at a level much lower than in the other dogs (3 centimeters below the origin of the ramus descendens).

This group constitutes a control series and the results are quite similar to those following ligation of the ramus descendens at the same level. Porter ligated this branch a few millimeters from its origin in 2 dogs. 1 died 4 days later the other 14½ days later. Miller and Matthews stated that either main trunk of the left coronary artery may be ligated without seriously disturbing the heart provided the ligation is distal to the septal branch. Leriche, Hermann and Fontaine concluded from their experiments that ligation of the ramus de-

scendens above its important first collateral branches is always fatal. According to Wood, Clark, and Wolfersb, ventricular fibrillation is the usual cause of death in coronary occlusion experiments. It occurs, as a rule within 3 or 4 minutes whenever the left posterior circumflex artery is occluded but more slowly after obstruction of the left anterior descending branch.

**Group 2.** Partial resection of the ramus descendens associated with ligation of the vena magna cordis. Fifty dogs were used in this series. Under positive pressure ether anesthesia, the pericardium was opened and the vena magna cordis was well exposed near the origin of the coronary sinus. Careful dissection of this vein is important because the proximity of the circumflex artery which lies closely beside it may result in its being included in the vein ligature. Such an accident is in most cases followed by ventricular fibrillation and death.

By means of a hook a thread was passed under the vein and the ligature was tied. This could be done without causing any bleeding and changes in the cardiac rhythm. Immediately after the ligation all the venous branches distal to the ligature dilated with blood and the anterior aspect of the heart took on a bluish color. The level of origin of the ramus descendens was then accurately localized and the trunk carefully dissected for a distance of 2 to 3 centimeters at the same



Fig. Cross section of the heart at 5 centimeters from the apex. There are no modifications in the thickness and in the structure of the walls.

level as in the control animals of Group 1. All small branches emerging from it were first ligated and then arteriectomy, as in Group 1, was performed. In no case during this second stage were any changes observed in the cardiac rhythm. Immediately after the resection it could be seen that the arterial segment distal to the resection was not emptied but was as full of blood as if there had been no interruption in the continuity of the vessel.

Five dogs died from infection of the wound and pleural effusion, 2 from air embolus apparently caused by excessive intrapulmonary pressure at the moment of closing the pleura, 4 died a few months later from intestinal disorders. The 39 remaining lived and were kept under observation for more than a year and a half. During the whole of this time they apparently were in perfect health. (It is interesting to note that a few became pregnant and gave birth to puppies without showing any signs of cardiac disturbances.) They were then sacrificed. The studies of the hearts by injections, x-ray, and histological sections will be described in detail in a further report. It may be stated now from the preliminary histological studies that the myocardial lesions vary greatly, in some instances an infarct and subsequent scar formation occurs, in others there are, after 1 year, no apparent lesions in the myocardial structure (Fig 2).<sup>1</sup>

**Group 3** Ligation of the vena magna cordis followed a year later by partial resection of the ramus descendens. Ten dogs were used in this series. As all the experiments and results were essentially the same, only 1 will be described in detail.

**Dog 51** On February 22, 1938, the vena magna cordis was ligated, and the postoperative course was uneventful. On March 7, 1939, partial resection of the ramus descendens was done. At this second operation the left lung appeared slightly adherent to the pericardium but was otherwise healthy. After careful liberation of this portion of the lung, the pericardium was incised. No fluid was present in the two surfaces of the pericardium did not seem to interfere with cardiac function. These adhesions were gently freed and the ramus descendens partially resected for 1.5 centimeters. The postoperative course was normal. On September 12, 1939, the dog

was sacrificed. The ramus descendens was found to have been resected at 1 centimeter from the left coronary orifice. The coronary arteries were then injected with a barium mass. During this procedure it was noted that the injection mass penetrated the pulmonary fibrous tissue adherent over the pericardium by way of 3 small arterial vessels. This has been noted in other cases as well.

**Histological report.** The parietal pericardium is completely adherent to the anterior surface of the heart, the posterior surface being free. There is a scar on the anterior surface of the heart extending for 3 centimeters from the apex. This scar measures 1.5 centimeters in width. The ventricular wall at the level of the scar measures 3 millimeters in thickness. The most important lesion is the scar on the anterior aspect of the heart. This scar is formed of a connective vascular tissue showing still at the extreme periphery a few living muscle fibers. The Hiss bundle fibers in the region of the scar are healthy. It appears that this scar tissue is not truly scar tissue in the strict sense of the word. It does not appear as newly formed connective tissue.

It appears to be old connective vascular tissue deprived of its muscle fibers. The vessels, arteries, and veins are numerous and free from disease. There is no sclerosis or increased thickness of the arterial walls. At 2.5 centimeters from the apex, the most important branches of the ramus descendens are normal.

#### ANALYSIS OF STUDY

There is considerable evidence, both experimental and from necropsy observation, that the myocardial ischemia of coronary disease has as its chief danger the unbalanced distribution of the blood flow through the coronary arteries, rather than the decrease in the total blood volume to the muscle. When the heart succeeds, as it often does, in overcoming by itself the ill effects of coronary narrowing or occlusion, it is not so much through acquiring additional blood from collateral sources outside the heart as through a re-adjustment of its own coronary circulation. Therefore, any surgical procedure designed to correct this unbalanced flow would seem both logical and justified.

The results of the experiments in Group 1 show that in most cases partial arteriectomy alone was incompatible with life. One must not forget, however, that these experiments were performed on normal dogs with normal arteries and that resection under such conditions produces a disturbance of the coronary blood flow far different from that which results from

<sup>1</sup>The first experimental results were communicated to the Montreal Physiological Society December 20, 1937.

gradually obliterating arterial disease in which the process is slow and in which the peripheral nervous pathways are not cut off.

It is suggested that if experiments could be conducted in such a manner as to reproduce fairly exactly the arterial conditions found in coronary thrombosis or occlusion it might be possible to demonstrate that the diseased coronary artery no longer a blood carrier acts as a foreign body which gravely disturbs the coronary circulation by initiating vasospastic reflexes. Such experiments are actually in progress.

The experiments in Group 2 demonstrate that ligation of the vena magna cordis has a protective effect against the ventricular fibrillation which so often occurs in acute ischemic conditions and also minimizes the myocardial changes which follow occlusion or partial resection of the ramus descendens.

Furthermore the experiments in Group 3 show that venous ligation has not merely a temporary value in improving coronary circulation even a year after venous ligation partial resection of the left ramus descendens, done at the same level as in Group 1 in which all the dogs died was not followed by death.

In 1937 Gross reported his attempts to increase the blood supply to the dog's heart by means of coronary sinus ligation. We have repeated these experiments in a series of 15 dogs. Either coronary sinus ligation was done or else partial obliteration by means of intra-sinusal or perisinusal escharotic injections as proposed by him. Coronary sinus ligation gave us high mortality and it is clear that occlusion of the venous drainage at such a high level is unnecessary to produce the desired effects. Injection of escharotics may be an advisable procedure in laboratory work but is dangerous in humans because of the necrosis which it sometimes produces in the right auricle and ventricle and of the serious inflammatory reactions which are set up in the pericardium.

Recently Gregg and Dewald performed experiments to study the immediate effects of coronary sinus and coronary vein occlusion on the coronary circulation. They found that the peripheral coronary backflow was markedly increased in the ramus descend-

ens after acute coronary sinus ligation. The maximum retrograde flow was reached in from 10 to 30 minutes, and after sinus release did not immediately return to the control backflow figure. The blood was highly unsaturated containing only 3 to 4 volumes per cent of oxygen. They concluded that sinus ligation does not prevent failure of contraction in a myocardial area from which the normal blood supply has been acutely removed and considered that such a procedure cannot be regarded as a method of choice for encouraging the blood supply to a potentially infarcted area.

These experiments varied in time from a few minutes to about 8 hours. Can one conclude from these results that if it should be possible to carry the same experiments for a longer period it may not show other facts demonstrating that venous ligation has a protective value in coronary occlusion or resection? The results reported in Group 2 and Group 3 when compared with those in Group 1 seem to justify a positive reply.

We do not yet understand exactly what are the circulatory mechanisms which are set up by venous ligation. It is probable that the blood reaching the distal end of the ramus descendens through branches of the right coronary artery but chiefly from those of the circumflex artery, passes from them through the capillary bed of the ramus descendens, and, as the ligation of the vena magna cordis prevents its easy return to the coronary sinus, it forces a circulation through smaller vessels in the vicinity.

Most workers who have studied the effects of venous ligation in arterial occlusion in the extremities by experimental and clinical observation agree that in both veins and arteries distal to the level of obstruction there is an increase in the blood pressure, and that incidence of gangrene is diminished. Our experiments seem to confirm their general findings when applied to the coronary circulation. Small infarcts are found in some cases but they are completely absent in others.

#### SUMMARY AND CONCLUSIONS

It has been suggested that the similarity of arteriosclerotic disease of the coronary arteries

and of the extremities should permit of the application in the heart of surgical methods found useful in the treatment of peripheral vascular disease. Experiments on dogs are described in which were performed (a) partial coronary arteriectomy of the ramus descendens, (b) partial coronary arteriectomy of the same arterial trunk combined with ligation of the vena magna cordis.

When partial resection of the ramus descendens at a high level was done a high mortality resulted. When the same procedure was carried out after venous ligation all dogs, apart from those dying of operative complications and intercurrent diseases, remained healthy for over a year.

It is concluded that vena magna cordis ligation in occlusion of the left ramus descendens helps to maintain adequate coronary circulation after partial coronary arteriectomy.

The results of these experiments suggest that in cases properly selected coronary vein ligation may be expected to act as a preventive measure against a second attack of coronary thrombosis and also to improve the coronary circulation sufficiently to relieve the pain of "angina of effort."

Furthermore it seems a logical procedure in traumatic surgery of the heart whenever it is necessary to ligate an important coronary arterial branch that is bleeding.

I wish to express my appreciation to Professor B. P. Babkin, professor of physiology, McGill University, for his constant interest and encouragement in this work, to Dr C. S. Beck for important advice on the management of the heart surgically, to Dr L. C. Smard for histological studies, to Dr H. Mortimer for the x-ray work he so generously carried on, and to Dr Melville for the electrocardiograms.

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# CARBOHYDRATE METABOLISM IN THYROTOXICOSIS

## I An Experimental Study

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THE relation of the thyroid secretion to metabolism is a problem that has attracted considerable interest. Though a voluminous literature attests the painstaking clinical and experimental studies that have been made, many of the ties in this relationship remain poorly understood.

### REVIEW OF LITERATURE

The early fund of knowledge—that is prior to 1900—was based almost entirely on clinical observations. It was observed that an increased thyroid secretion was associated with an increase, and the hypothyroid state with a decrease in both the total and protein metabolism. In addition there was known to exist some derangement in the metabolism of carbohydrate, for it was noted that the exophthalmic goiter syndrome was sometimes associated with a persistent or transient glycosuria. Further in some obese or myxedematous individuals, glycosuria followed the administration of thyroid extract only to disappear when the extract was discontinued. The interpretation of these observations was that hyperthyroidism was associated with a decreased glucose tolerance. Magnus-Levy and Garrod gave accounts of this literature.

With the turn of the century experimental study began to supplement clinical investigation. Eppinger, Falta, and Rudinger studied the relationship between the thyroid gland and the metabolism of carbohydrate. They reported that epinephrine injected into thyroidectomized dogs failed to produce the glycosuria that occurred in normal animals. From the precedent of studying these changes in the thyroidectomized animal, conflicting reports appeared in the literature. Most workers continued to agree that an excess thyroid secretion augmented both the total

and nitrogen metabolism but an uncertainty arose as to the effect on the metabolism of carbohydrate. Opinion became divided as to whether the thyroidectomized animal possessed an increased or decreased tolerance for glucose. This uncertainty was due to the fact that most studies were made on thyroidectomized dogs. Because of the close anatomical relationship of the thyroid gland and parathyroid glands in this animal, it was difficult to recognize the separate effects of thyroidectomy and parathyroidectomy. Reviews of this literature were given by Cramer and Krause (7) and Kuriyama.

As additional studies were made to clarify this controversy another thought was introduced into the experimental studies of hyperthyroidism. The effect of feeding thyroid to the normal animal was coming under consideration. Carlson and his co-workers in a series of observations found that desiccated thyroid given by mouth is toxic for many animals and that different genera exhibit great variation in their susceptibility. Dogs, cats, foxes, and ducks were most resistant; rodents and primates the least. French confirmed the toxicity of thyroid for rabbits, rats, and guinea pigs. Control animals fed with other organs or tissues failed to reveal evidence of toxicity.

At this time Cramer and his associates started a series of investigations into the effect of thyroid feeding on metabolism. Because of the far-reaching influence of their communications the salient features are recalled in a brief summary. In a preliminary report, Krause and Cramer (26) reported a lowering for the limit of assimilation of glucose in thyroid fed dogs. In their next paper (7) they reported that after feeding thyroid for 2 or 3 days to rats and cats, there was a complete loss of liver glycogen. Since the animals were fed a carbohydrate-rich diet and no reducing sugar was found in the urine the

interpretation was that the thyroid hormone acted specifically on only one phase of carbohydrate metabolism, and that was to inhibit the formation and storage of glycogen in the liver. After a lapse of 4 years, Cramer and McCall (8, 9, 10, 11) renewed the studies to investigate the gaseous metabolism of thyroidectomized and thyroid-fed rats. Each communication added new factors to account for the deranged metabolism of carbohydrate. Their final interpretation was as follows: In thyroid-fed animals the liver formed glycogen all the time. But the excess thyroid hormone stimulated the suprarenal glands to greater activity and this increased the mobilization of hepatic glycogen. The organism responded to this carbohydrate plethora by increasing the oxidation of carbohydrate. When the glycogen reserve was depleted, the preformed carbohydrate of the diet was inadequate to meet the increased demand for carbohydrate and there was a breaking down of body fat and protein to form carbohydrate for oxidation. On this basis it was suggested that the hyperthyroid patient be fed a diet rich in carbohydrate "to counteract the loss of flesh."

The studies by Cramer and his associates exerted considerable influence in shifting interest from the altered fat and protein metabolism to that of the deranged metabolism of carbohydrate. To facilitate a review of the inquiries into the deranged metabolism of carbohydrate, the key references are divided into one of three groups. One group investigated the changes in blood and urinary sugar. The second studied the utilization of glucose as influenced by an excess thyroid secretion, whereas the third investigated the rôle played by the liver in hyperthyroidism.

The change of interest in this interval was further facilitated by standardization of methods for the determination of blood sugar. With this standardization a number of workers studied changes in the blood and urinary sugar, before and after the administration of glucose. Contributions to this subject by Gevlin and others (12, 18, 21, 30) served to establish a number of observations. Neither a fasting hyperglycemia nor a spontaneous glycosuria was of constant occurrence in hyperthyroidism, but after a glucose test meal

there was an alimentary hyperglycemia. Associated with the administration of glucose, sugar was usually spilled in the urine. With the clinical improvement that followed rest or operation, there was a reduction in the hyperglycemia and glycosuria. No relationship was demonstrated between the severity of intoxication and degree of impaired tolerance.

Another demonstration of this impaired tolerance was made by Wilder and Sansum (36). In a clinical study of glucose tolerance they employed the continuous, timed, intravenous injection of glucose. Their observations were made in normal human individuals and in a series of pathological conditions, of interest being the 5 patients with exophthalmic goiter. In the normal individuals glucose was injected up to a rate of 0.85 gram per kilogram body weight per hour without producing glycosuria. But in the patients with exophthalmic goiter, sugar appeared in the urine with slower rates of injection ranging from 0.5 to 0.65 grams glucose per kilogram body weight per hour. From these findings they concluded that patients with an increased thyroid function uniformly showed a diminished rate of tolerance for the intravenous administration of glucose.

This syndrome of a decreased tolerance for glucose suggested that the altered carbohydrate metabolism of thyrotoxicosis may be analogous to the derangement observed in diabetes mellitus. John (22, 23, 24) and Wilder (35) reviewed this literature and made an extensive clinical study of this relationship. They demonstrated that hyperthyroidism does not act as an exciting etiological factor of diabetes mellitus but that it might fan a latent diabetes into activity or intensify a diabetes already present. The clinical importance in this relationship was that the exophthalmic goiter syndrome reduced the ability of the diabetic patient to utilize carbohydrate, decreased the efficiency of the unit of insulin, and increased the danger of sudden onset of diabetic coma. Control of the hyperthyroidism by rest, administration of iodine, and operation greatly improved the diabetic patient's tolerance for carbohydrate.

These inquiries led to the second group of studies, namely, the investigation of glucose

utilization in hyperthyroidism. This included both clinical and experimental investigations. DuBois in direct calorimetric studies of patients with exophthalmic goiter demonstrated that there was no interference with the oxidation of carbohydrate. Sanger and Hun studied changes in the blood sugar and respiratory quotient, before and after the administration of glucose. They concluded that individuals with thyrotoxicosis burned carbohydrate readily but that the liver was unable to store glycogen. Mirsky and Broh Kahn made direct observation on the utilization of carbohydrate in experimental hyperthyroidism. They studied the rate at which glucose disappeared from the blood of eviscerated rabbits. In the control rabbits the average disappearance in 1 hour was 35.6 per cent. In the hyperthyroid rabbits the average disappearance in 1 hour increased to 75.6 per cent, demonstrating that the extrahepatic tissues of the hyperthyroid animal removed glucose from the blood at a greater rate than did those of the normal animal. Since the liver was not present to influence the blood sugar the increased utilization of glucose by the extrahepatic tissues was not secondary to any defect in the glycogenic or glycogenolytic mechanism of the liver.

In the third and last major group of communications interest was centered on the rôle played by the liver. This group more than the others, gave rise to considerable confusion. Most of the studies followed the report by Cramer and Krause that thyroid feeding depleted the liver of its glycogen reserve. As pointed out before Cramer and Krause in their initial studies, believed that in hyperthyroidism, the liver was unable to form or store glycogen. On this basis there followed in the past two decades a stream of experimental studies designed to demonstrate in one fashion or another that thyroid feeding depleted the liver of its glycogen reserve. Confronting this group a number of clinical observations suggested that the liver was not primarily responsible for the altered metabolism of carbohydrate. Richardson Levine and DuBois studied the curves of the respiratory exchange in a normal individual and in 2 cases of exophthalmic goiter. They con-

cluded that there was no defect in the mechanism by which glycogen was stored and estimated that the glycogen reserves were as large in the 2 patients with exophthalmic goiter as in the normal subject. Later Johnston made a similar study in children with exophthalmic goiter and demonstrated that there was no impairment in the oxidation of carbohydrate. He also pointed out that when the glycogen stores were well maintained through rest and diet, injected glucose was oxidized more readily in the patients with exophthalmic goiter than in normal individuals. Two schools of thought developed from these conflicting reports. One based on experimental studies contended that the liver in hyperthyroidism was unable to form and store glycogen. The other based on indirect clinical observations, maintained that the liver did form and store glycogen.

To help clarify this controversy a smaller but no less significant group of studies gave some aid to this problem. Burn and Marks (19) studied the function of the liver as it contributed to maintain a constant blood sugar level. In their thyroid-fed animals they found the liver more responsive to the stimuli that promoted glycogenolysis. The result was a ready release of stored glycogen. Similarly John quoted the studies of Charvát and Gjurič (3, 4) who demonstrated that in exophthalmic goiter the glycogen poor liver was in a state of shock and that it not only bound glycogen loosely but released it readily.

#### STATEMENT OF PROBLEM

In the review of the literature the purpose was to follow the progress in our understanding of how an excess of the thyroid secretion influences metabolism. It was pointed out that by the latter years of the nineteenth century clinical study had shown that an increased thyroid secretion was associated with some derangement in the metabolism of carbohydrate. Then with the turn of the century experimental work demonstrated that thyroid feeding depleted the liver of its glycogen reserve. This stimulated a long train of both experimental and clinical investigations. It was first demonstrated that hyperthyroidism was associated with a decreased

tolerance for glucose. Since the decreased tolerance observed in hyperthyroidism resembled the impairment in diabetes mellitus, it appeared that a relationship might exist between these entities. Although further study failed to demonstrate any direct relationship between hyperthyroidism and diabetes mellitus, it led to the investigation of glucose utilization in hyperthyroidism. This latter investigation demonstrated that the extrahepatic tissues of hyperthyroidism burned glucose with avidity. Paralleling these studies other workers tried to correlate these observations with the impoverishment that occurred in the hepatic store of glycogen. Some insight was given by demonstrating that the hyperthyrotic liver bound glycogen loosely and released it readily, but a fundamental problem was still concerned with what rôle the hyperthyrotic liver played in this deranged metabolism of carbohydrate.

#### MATERIALS AND METHODS

Male albino rabbits—species of New Zealand white—were used exclusively in this study. All animals were of the same colony completing their active growth at 9 months with a body weight of 3.0 to 3.2 kilograms. The rabbits were a "small breed" of New Zealand white. In accordance with the precedent set by the literature the animals were selected for study when they attained a weight of 2.7 kilograms (approximately 6 pounds). At this weight the rabbits were from 7 to 8 months of age and had completed their active growth. The animals were housed in regulation-size hutches and gentled throughout the periods of observation. Twice daily they were fed weighed portions of a commercial combined ration (Victoria rabbit feed). Fresh water was supplied *ad libitum*. Each morning when the animals were weighed any food that remained was again weighed to determine the intake for the preceding day. After an adequate control period, thyroid was given orally and the dose controlled by mixing pulverized desiccated thyroid tablets with each feeding.

For comparison and control on the changes in weight a litter of 7 rabbits was reared for a period of 1 year. Food was supplied *ad*

*libitum* and each animal was weighed every second day. This formed the basis for the normal growth curve representative for this colony. Unfortunately, at the time of this study the significance of determining the normal food intake (to supplement normal growth curve) was not appreciated, so data on the normal food consumption are in part lacking.

The glycogen content of the liver was determined in both normal and thyroid-fed animals. In the early periods of study a surprising lability was noted in the glycogen stores of the liver. Because of this lability, study of the normal rabbits was not designed to effect the conventional uniformity. Instead, the animals were studied only after quantitative changes were made in the diet. The purpose was to note the latitude of glycogen storage in normal animals. In the thyroid-fed animals a standardized method of study was developed. When an experiment was interrupted in the terminal stage of thyroid feeding the hepatic store of glycogen was exhausted. Since an attempt was made to correlate the status of the glycogen deposit in the liver with other observations, the plan was altered to interrupt each experiment before the onset of the terminal stage. With this modification titratable quantities of glycogen were present, and it is on this basis that the animals in this paper were studied. Food was withdrawn the night before so that an 8 hour fast preceded the removal of samples from the liver. Following the precedent of other writings the glycogen determinations were made in duplicate. In the first experiments, samples of liver were removed after the animal was stunned by a sharp blow over the occiput. But after the studies were in progress it was learned from a paper by Cori that with stunning of an animal the profound discharge of nervous impulses might alter the glycogen content of the liver. The method was then changed first to anesthetize each animal with the intravenous administration of sodium pentobarbital. The subsequent procedure was carried out according to Sahuyn's modification (33) of Pflueger's method for the determination of glycogen. The sugar content of the hydrolyzed samples was determined by the standard method of Folin and Wu.



## EXPERIMENTS AND OBSERVATIONS

Influenced by the literature this study of a deranged carbohydrate metabolism began by investigating the glucose tolerance curve of thyroid-fed rabbits. Following the precedent set by other workers rabbits were fed 5 grains of desiccated thyroid daily and the glucose tolerance curve studied after varying periods of thyroid administration. The results were similar to the observations made by Burn and Marks in that the character of the glucose tolerance curve varied with the duration of thyroid feeding. As outlined herein Burn and Marks explained these variations on the basis of the sugar-regulating mechanism of the liver.

While a study of the changes in the glucose tolerance curve was being made there was noted a loss of appetite following the institution of thyroid feeding. Since hyperthyroidism was reputed as having associated with it not only an increased but an almost voracious appetite, this observation was confusing. The first reaction was that the appetite loss was due to some error or unusual circumstance in the method of study. But with repeated experiments a loss of appetite frequently followed the administration of thyroid. It then appeared that thyroid substance an animal protein and foreign to the natural diet of a rabbit might be responsible for this anorexia. To test this possibility a number of changes were made in the routine of feeding. When an animal refused the feeding ration mixed with thyroid the mixture was withdrawn and replaced by a fresh supply of the ration. Almost invariably the animal would refuse the new feeding. Since they now refused the ration they ate readily under normal conditions it appeared that the presence of thyroid powder in the ration was not objectionable. For another test animals were selected that had refused both the plain and thyroid-mixed feedings. They were tempted with tastier morsels as carrots, fresh lettuce and greens. When an item was found that the rabbit would eat it was sprinkled with thyroid powder and again offered. A refusal of these items could not be effected by the addition of thyroid powder and from this it was concluded that the presence of thyroid powder in

the ration was not responsible for the loss of appetite.

At this point it was thought that if the amount of thyroid was increased, the disproportion between the augmented metabolism and the amount of food taken would be so great that the animal might develop an increased or voracious appetite. Accordingly additional series of rabbits were fed first 7.5 then 10, and finally 15 grains of desiccated thyroid daily. The results were the same for even with the extreme intoxication effected by the massive doses of 15 grains daily—the appetite remained poor.

It was during the feeding of these larger doses that the appetite loss was demonstrated impressively through an accident. Two male rabbits, identical litter mates, were housed in adjacent hutches. It was planned to feed one rabbit 10 grains of thyroid daily and the other was to serve as a control. But after the second day of thyroid feeding it was noted that the control animal had an almost complete loss of appetite and was steadily losing weight. Because of the identical appearance of the animals it required several days to learn that through an accident the control animal had eaten the thyroid food mixture. By this time the animals were lost to the proposed plan of study. That some value might be derived from this incident the feeding of thyroid was discontinued but observations on the changes in weight and food consumption were continued. The effects of this single massive dose of thyroid are illustrated in Chart 1.

As the duration for each experiment was extended and an increasing number of animals was studied, the changes in appetite associated with the prolonged administration of thyroid conformed to a definite pattern. A graphic illustration of this pattern based on the data of 3 rabbits receiving 7.5 grains of desiccated thyroid daily is given in Chart 2. The pattern consisted of four phases or periods. In the first few days there was no change in the amount of food normally taken. Following this latent period the first effect of thyroid feeding was signalled by a loss of appetite. The extent of this anorexia was variable. In some animals there was a prompt and complete loss of appetite. In others the loss of

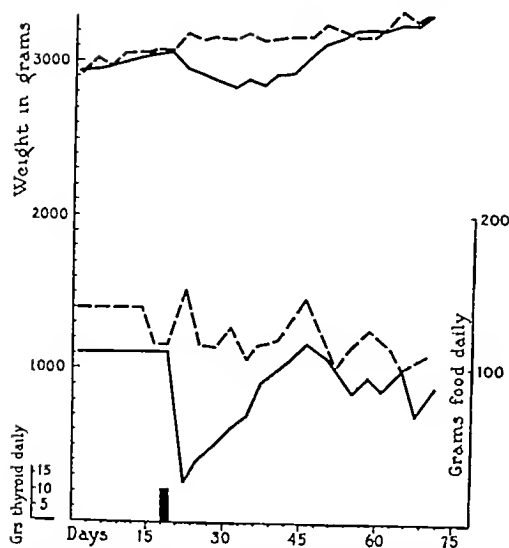


Chart 1. Illustrating the effects of a single massive dose of thyroid (20 grains in 24 hours). Solid lines represent thyroid fed rabbit, broken lines, the normal control. The sudden loss of appetite and weight loss following thyroid feeding was well defined. As the effect of thyroid was spent the appetite improved and there was a corresponding gain in weight.

appetite was less marked and developed gradually. Paralleling the diminished intake of food was a corresponding loss in weight. With the continued administration of thyroid the animal entered a second period of improvement. In the second period the appetite improved and there was a corresponding gain in weight. But these changes were also variable. Rarely did the appetite improve to exceed the normal intake. More often the improved appetite approached, but fell short, of the normal level. In still others the appetite showed no improvement and lagged at a low ebb for the remainder of the experiment. The maximal improvement attained in the second period marked the beginning of the third period. In contradistinction to the short, fulminating, preliminary phases, the third period was of longer duration and quiet. The appetite continued on its improved level with but minor fluctuations but the weight curve took on a gradual decline. After a long period the third phase gradually merged into the brief fourth period. The last period began with a fall in the appetite from its sustained

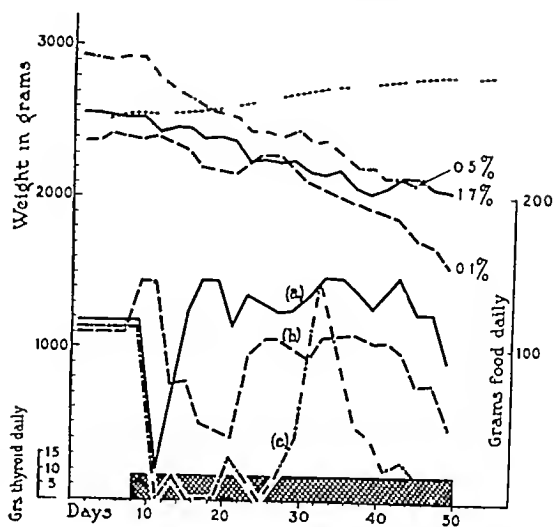


Chart 2. A comparative illustration of the appetite changes associated with the prolonged feeding of  $7\frac{1}{2}$  grains of thyroid daily. All 3 rabbits illustrate the sudden loss of appetite that immediately follows the institution of thyroid feeding. Subsequently, the appetite in rabbit A improved to exceed the normal intake. In rabbit B the improvement fell short of the normal level. In rabbit C the appetite failed to recover from its initial loss and continued at a low ebb for the duration of the experiment. The effect of the appetite on the weight curve and hepatic store of glycogen is also illustrated. The number at the end of each weight curve gives the average liver glycogen in milligrams per cent. The dotted line represents the normal growth curve for this colony.

level. There was a corresponding loss in weight and the animal began to manifest a growing weakness. As the last period progressed it gained momentum and in the brief anticlimax there was a complete abstinence from food with a precipitous fall in weight. A marked asthenia developed and with complete exhaustion the animal died. The last period was also variable. In some animals the fatal end approached rapidly, in others, the final succession of events was prolonged.

As the changes in appetite were formulating this pattern, the glycogen content of the liver was determined at the end of each experiment. Five normal and sixteen thyroid-fed rabbits were studied. The thyroid-fed rabbits were divided into four series. This division was based on the amount of thyroid fed each animal. Each series was further subdivided into pairs, as determined by the amount of food taken during the period of thyroid feed-

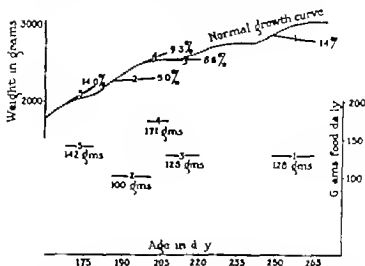


Chart 3. A comparative illustration of the changes in weight and hepatic store of glycogen in normal rabbits following quantitative changes in the diet.

ing. The changes observed are graphically illustrated in Charts 3, 4, 5, 6 and 7. In these charts the solid lines represent animals with the better appetites, the broken lines those with poorer appetites. The figure at the end of each weight curve is the average value for liver glycogen in milligrams per cent.

As indicated under materials and methods, the control animals were not studied to effect the conventional uniformity. Instead they were sacrificed only after quantitative changes were made in the diet. The purpose was to note to what extent the normal hepatic store of glycogen was influenced by quantitative changes in the diet. This in turn was to aid the understanding of changes that occurred in the hepatic stores of glycogen under the influence of thyroid feeding. The results of the control experiments are illustrated in Chart 3.

In the control animals the influence of the appetite level on the quantitative store of glycogen was better appreciated when the corresponding weight curve of the animal was taken into consideration. This is best illustrated in rabbits 1 and 3. The appetite level was the same in both rabbits. But in the smaller animal rabbit 3 the diet was sufficient to effect a normal weight gain whereas

the larger animal rabbit 1 actually lost weight. The combination of these changes was reflected in the quantity of glycogen stored in the liver.

In the thyroid fed animals, three factors were noted in studying the glycogen content of the liver. First, the hepatic store of glycogen was depleted only in the terminal period of thyroid feeding, and that was when the animal was moribund. When an experiment was interrupted before the terminal period a definite store of glycogen was present even though the animal received thyroid for a long period. This was important for it indicated that the liver formed and stored glycogen. Second, the animals that maintained higher appetite levels had the larger stores of glycogen. Since the liver that received the more abundant supply of materials from which to store glycogen was the liver that had the larger store of glycogen indicated again that the liver formed and stored glycogen. The third factor and that was the daily dose of thyroid also had a direct influence on the quantitative store of glycogen. The animals fed small doses of thyroid had larger stores of glycogen demonstrating that the degree of intoxication had a direct influence on the quantity of glycogen stored in the liver. This was true for all animals except those receiving

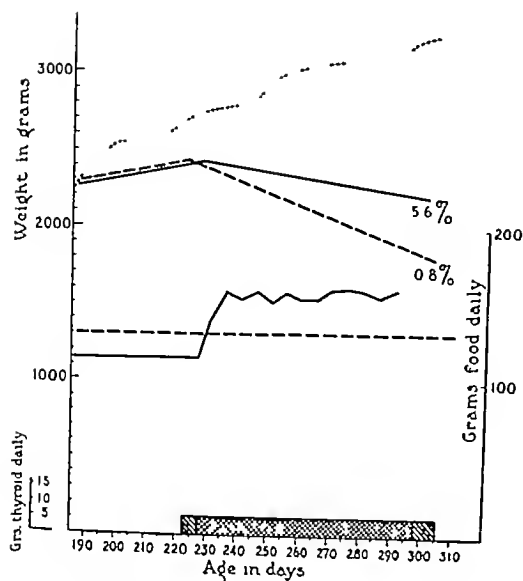


Chart 4 Illustrating the changes in weight and appetite associated with the prolonged administration of 5 grains desiccated thyroid daily. Solid lines represent animals with the better appetites, broken lines those with poorer appetites. The numbers at the end of each weight curve give the average liver glycogen in milligrams per cent. The dotted line represents the normal growth curve for this colony.

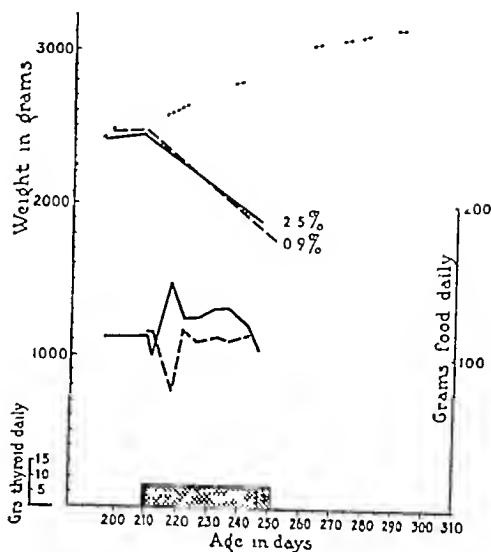


Chart 5 Illustrating the changes in weight and appetite associated with the prolonged administration of 7 1/2 grains desiccated thyroid daily. Solid lines represent animals with the better appetites, broken lines those with poorer appetites. The numbers at the end of each weight curve give the average liver glycogen in milligrams per cent. The dotted line represents the normal growth curve for the colony.

7.5 grains daily. In this series the glycogen content was too small to correspond with the regular decline that followed the larger doses of thyroid. There were two reasons for this discrepancy. One was that the feeding of thyroid was unintentionally prolonged in this series to almost the terminal period. As a result the hepatic store of glycogen was reduced to a minimum and this reduced the average for the series. The other reason was that the two rabbits in this series having the best appetites, in reality, ate only fairly well as compared to similar animals in the other series. The findings for the thyroid-fed animals are illustrated in Charts 4, 5, 6, and 7.

Since the appetite level and degree of intoxication had a direct influence on the hepatic store of glycogen there remained to consider the element of time. The duration of thyroid feeding did not influence directly the quantitative store of glycogen. The only relationship was relative, for a lessening in the store of glycogen was associated with the early or terminal period of thyroid feeding. This demon-

strated again that with long periods of thyroid feeding the liver still formed and stored glycogen.

When it was evident that glycogen was formed and stored in the liver and that the appetite level influenced the quantity of glycogen stored, the reaction was to have the animals eat more. Any measure that would increase the hepatic store of glycogen would be of therapeutic value and would prepare for a better understanding in the relation of the thyroid secretion to metabolism. Since the ration used was satisfactory, it was evident that more than an ample supply of food was needed. At first the rabbits were urged with alfalfa hay, lettuce, carrots, cabbage and other items, but these were refused. Since the normal desire to eat was lacking it was thought to create a false appetite with the injection of insulin. The initial doses were small and ineffective. Subsequently, the amount of insulin was increased until some animals were receiving 100 units of protamine-zinc insulin daily—but to no avail. Vitamin

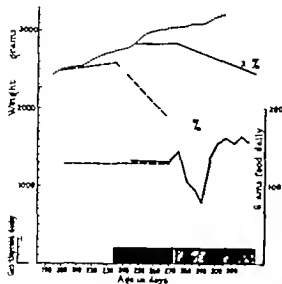


Chart 6. Illustrating the changes in weight and appetite associated with the prolonged administration of 10 grains desiccated thyroid daily. Solid lines represent animals with the better appetites, broken lines those with poorer appetites. The numbers at the end of each weight curve give the average liver glycogen in milligrams per cent. The dotted line represents the normal growth curve for this colony.

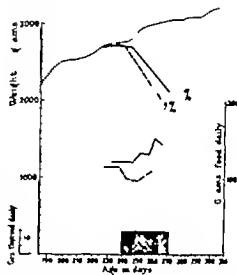


Chart 7. Illustrating the changes in weight and appetite associated with the prolonged administration of 5 grains desiccated thyroid daily. Solid lines represent animals with the better appetites; broken lines, those with poorer appetites. The numbers at the end of each weight curve give the average liver glycogen in milligrams per cent. The dotted line represents the normal growth curve for this colony.

B was also tried. A slight improvement was noted when vitamin B supplemented the ration but with the conditions that governed these experiments the results were negligible. Finally it was concluded that the appetite could not be stimulated to a satisfactory level.

One of the most important factors in this study was the evidence indicating that in hyperthyroidism the liver formed and stored glycogen. Because the evidence supporting this contention was based on indirect observations it was felt necessary to offer more conclusive evidence in the form of direct observations. This motivated an investigation of the glycogen content of the liver in normal and thyroid-fed animals, before and after the intravenous administration of glucose.

#### MATERIALS AND METHODS

The principle was to determine the glycogen content of the liver before and after the intravenous administration of glucose. Full grown, male rabbits, of the same colony were used for these experiments. After suitable control period, hyperthyroidism was produced by the oral administration of 7.5 grains desiccated thyroid daily. Food and water

was supplied *ad libitum*. The animals are housed and cared for as detailed before.

Two normal and 5 thyroid-fed animals were studied. The thyroid-fed animals were selected for study when a definite hyperthyroidism was evident. The shortest period of thyroid feeding was 27 days, the longest period 53 days with an average duration of 40 days. Food was withdrawn the night before so that an 8 hour fast preceded the time of study. The following morning light anesthesia was effected by the intravenous injection of sodium phenobarbital. Sodium phenobarbital was chosen because the action is of longer duration than is that of other barbiturates and also because the anesthesia effected by it is reputed not to interfere with the formation and storage of glycogen in the liver. The abdominal wall was prepared aseptically and all procedures were carried out under aseptic conditions. The proposed line of incision in the right upper quadrant was infiltrated with one half per cent solution of novocain (without epinephrine). This insured against any reaction by the animal. The peritoneal cavity was entered through a small incision. The presenting edge of liver was gently mobilized and a narrow strip of hepatic tissue, about 1 by 6 centimeters, was excised from the peripheral margin. The strip of tissue was quickly divided into samples and transferred into weighed tubes of hot potassium hydroxide. There was little bleeding from the cut edge. When hemostasis as needed sutures of fine silk

were carefully tied over the cut edge. As an added precaution a slip of omentum was incorporated under the ligatures. The abdominal wall was closed in layers. The external jugular vein on one side was exposed, cannulated, the time noted, and the intravenous administration of 5 per cent glucose in normal saline begun. To insure an ample supply of glucose, the solution was administered at a rate calculated to supply 0.8 to 0.9 grams glucose per kilogram body weight per hour. After an average of 4.5 hours of venoclysis preparations were made to continue the experiment. The abdominal wall was again infiltrated with plain novocain and the peritoneal cavity was opened. Following a brief inspection to make certain there was no bleeding in the interim, a lobe of liver (other than the one selected for the first biopsy) was mobilized and a section of hepatic tissue was excised. The section of liver was cut into samples. Each sample was gently but quickly blotted on a soft cloth to absorb any excess glucose laden blood, and transferred to weighed tubes of hot potassium hydroxide. The urine in the bladder was removed for the quantitative determination of glucose, and the animal sacrificed.

The glycogen determinations were made after Sahyun's modification of Pflueger's method. The sugar content of hydrolyzed samples was determined by the standard method of Folin and Wu. The first determinations were made in duplicate but when the wide variation between samples was noted, a larger number of samples was taken.

As just given, the rate of glucose administration was calculated to make available an ample but not exorbitant supply of glucose. This was reasonably successful for a definite but small quantity of glucose spilled into the urine of each rabbit. The direct observations made in these experiments demonstrated that the liver in hyperthyroidism formed and stored glycogen. The results for each rabbit are graphically illustrated in Chart 8. In the control rabbits the average store of hepatic glycogen increased from 1.7 per cent to 4.2 per cent after an average of  $4\frac{1}{4}$  hours of glucose venoclysis. In the thyroid-fed rabbits the average store of glycogen increased from 1.0 per cent to 5.2 per cent after an average of  $4\frac{3}{4}$  hours of glucose venoclysis.

#### RESULTS OF STUDY

The experiments in this study demonstrated first, the changes in appetite associated with the prolonged administration of thyroid and second, that glycogen was formed and stored by the liver in hyperthy-

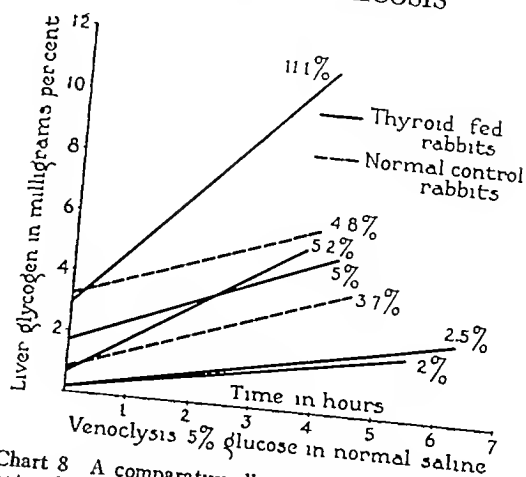


Chart 8. A comparative illustration of the changes in hepatic glycogen following the intravenous administration of glucose. Solid lines represent the storage of glycogen in thyroid fed rabbits, the broken lines, the storage in normal rabbits.

The changes in appetite conformed to a pattern of four periods. Further, when each experiment was concluded and the appetite pattern viewed in its entirety, it was found that the animals frequently ate less during the period of thyroid administration than under normal conditions. But this varied. Some animals maintained appetites less than normal, others maintained normal appetites, and still others maintained appetites that surpassed the normal intake. Of more significance, however, was the fact that the appetite was never sufficient permanently to counterbalance the augmented metabolism.

When the diminished appetite was established by this study, confirmation of this observation was looked for in the literature. In other communications on experimental hyperthyroidism the loss of appetite was occasionally mentioned, but no significance was credited this observation. The explanation for this undoubtedly lies in the stereotyped experiment that was used. The experiments were incomplete from the standpoint of time and too fulminating to delineate the series of changes taking place. Consequently, the recognition of this appetite pattern was held in abeyance. On the clinical side a similar problem was found. A decreased appetite in clinical hyperthyroidism was mentioned on occasions, but in no instance was the signifi-

TABLE I—APPETITE CHANGES IN CLINICAL HYPERTHYROIDISM

Number of Cases	Relative change in appetite	Duration of symptoms in months	Average R. M. E. iodine intake	Weight loss		Age
				percentage	amount in lbs.	
	Less than Normal	5	40	25	15	30
30	Normal	15	44		14	
17	More than Normal		42	19		30

cance of this observation recognized. The only exception was a recent communication by Frazier and Ravdin in which the authors reported a decreased appetite in some of their thyrotoxic patients and interpreted this change as a significant part of the general picture of thyrotoxicosis.

Since a loss of appetite was commonly associated with the administration of thyroid and only meager evidence to support this observation was found in the literature, inquiries were made into the appetite level of thyrotoxic patients on the service of Dr. Richter. Individuals with a definite thyrotoxicosis that had not received iodine or medical management were carefully questioned as to the status of the appetite. The purpose was to determine if the patient ate less than normal normally, or if the appetite was increased to more than the normal level. On this basis one hundred patients were interviewed. Forty three per cent stated that they ate less than normal, 30 per cent gave histories of a normal appetite whereas only 27 per cent reported that they ate more than under normal conditions. If the appetite pattern outlined for experimental hyperthyroidism had a counterpart in clinical hyperthyroidism the poorer appetite levels would be found in the earlier periods of thyrotoxicosis while the normal or increased appetites would be found more often in the later periods. With this in mind, it is interesting to note in Table I the short duration of symptoms associated with poor appetites as compared with the longer duration of symptoms associated with the normal or increased appetites. Since the average age and degree of intoxication were essentially the same for all series, this observation took on added significance. Definite conclusions cannot be drawn

from this small volume of material and particularly because all of the findings were not based on controlled objective data. Notwithstanding I believe that if the appetite changes in clinical hyperthyroidism were carefully studied, the clinical findings would be similar to the experimental findings outlined in this paper. It is obvious that any clinical study contemplated in that direction must exclude the ameliorating influence of iodine, bed rest, roentgen-ray or other therapeutic agent.

In addition to the changes in appetite, the experiments in this study demonstrated that the liver in hyperthyroidism formed and stored glycogen. This was important not only because of its fundamental significance, but also because it offered an explanation for the confusion in the literature on this question of glycogen storage. As pointed out in the review of literature the studies of a deranged carbohydrate metabolism in hyperthyroidism took—and for the most part continue to take—their cue from the first communications by Cramer and Krause (7, 16). Cramer and Krause demonstrated that thyroid feeding depleted the hepatic store of glycogen. Their interpretation was that the liver was unable to form and store glycogen. This was a striking demonstration. It introduced a new thought to account for the deranged metabolism of carbohydrate in hyperthyroidism and immediately stimulated investigation of the problem. Unfortunately the subsequent studies by Cramer and McCall (8, 9, 10, 11), demonstrating that glycogen was formed and stored by the liver, did not appear until after a lapse of 4 years. In the interim the die was cast, for the studies of this derangement adhered to the precedent laid down in the first papers by Cramer and Krause. In following this precedent the experiments were based on short periods of observation. The practice was to administer thyroid for 1 or 2 weeks, occasionally for 3 weeks and rarely for periods of 2 or more months. When this acute experiment is interpreted in terms of the appetite pattern it is understood why there was reported with such unanimity a depletion in the hepatic store of glycogen. Normally the hepatic store of glycogen is of labile construction

Hyperthyroidism increases this lability so that the liver not only binds glycogen loosely but releases it readily. Now, when there was superimposed on this fleeting structure an augmented metabolism and a decreased appetite it is clear why experiments interrupted in the early periods of thyroid feeding revealed a shortage in the hepatic store of glycogen. Had the administration of thyroid been continued until the appetite was established on a higher level and then the experiments interrupted—higher values for the glycogen content of the liver would have been reported. The evidence presented in this study bears out this interpretation.

In concluding this discussion of the changes in appetite and glycogen content of the liver, a plan is outlined that is believed to account for the series of changes observed in experimental hyperthyroidism. With the institution of thyroid feeding the following sequence is noted. After a latent period of 1 to 3 days there is a loss of appetite. The loss of appetite is associated with a corresponding loss in weight and impoverishment in the hepatic store of glycogen. The extent to which the hepatic store of glycogen is impoverished is determined by the degree of intoxication and the level to which the appetite is depressed. If the administration of thyroid is continued, a second period of improvement follows. The appetite improves, but the improvement is variable. In some animals the appetite never recovers from its initial fall and continues at a low ebb for the remainder of the experiment. In other animals the improvement ranges somewhere between the exhausted level and the normal intake. In still others and this is the exception and not the rule—the appetite increases to exceed the normal intake. With the improved appetite there is a gain in weight and replenishment in the hepatic store of glycogen. The maximal point of improvement attained in the second period marks the beginning of the third period. In the third period the appetite is sustained on an improved level. As the third period progresses the disproportion between the food intake and augmented metabolism increases. This is manifested by a progressive loss in weight and lessening in the glycogen store of the liver.

After a long interval the third period gradually merges into the fourth and last period of thyroid feeding. The last period, depicting the collapse in animal economy, begins with a decline of the appetite from its sustained level. The decline is at first gradual, then accelerates, and in a short period develops into a complete anorexia. This is associated with a precipitous fall in weight and exhaustion of the hepatic store of glycogen. The animal develops a profound muscular weakness and dies from exhaustion.

#### SUMMARY

- 1 An appetite pattern of four periods or phases was associated with the prolonged administration of thyroid.
- 2 The amount of food taken by an animal during the period of thyroid administration was frequently less than the amount of food taken under normal conditions.
- 3 In one hundred cases of clinical hyperthyroidism the appetite pattern was similar to the pattern observed in experimental hyperthyroidism.
- 4 Direct and indirect experimental evidence demonstrated that the liver in hyperthyroidism formed and stored glycogen.
- 5 The appetite level maintained by an animal during the period of thyroid feeding had a direct influence on the quantity of glycogen stored in the liver.
- 6 The degree of intoxication, experimentally determined by the amount of thyroid administered, had a direct influence on the quantitative store of hepatic glycogen.
- 7 The time element, as determined by the duration of thyroid feeding, had only a relative influence on the hepatic store of glycogen.

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# OBSERVATIONS ON THE ROENTGENOLOGICAL EVIDENCE OF FETAL DEATH

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ATTENTION was first called to the value of roentgenography as a means of determining fetal death *in utero* by D A Horner in 1921 in a thesis presented before the Chicago Gynecological Society. At that time he stated that "overriding of the skull bones with cephalic asymmetry are signs of fetal death." Since that time a good deal of attention has been given to this subject by various observers and in 1931 Szello presented a summary of the changes in the fetal skeleton which might give diagnostic information. These are (1) flattening of the fetal skull, (2) marked bending of the spinal column, which is the earliest sign, (3) overlapping of the skull bones with decrease in the radius of the skull, (4) later, separation of the skull bones, (5) asymmetry of the skull, (6) failure of the size of the bones to correspond with the duration of pregnancy, (7) haziness of the bony landmarks and contours, or entire disappearance of the bony shadows.

It seems to be well established from autopsy findings of the newborn that brain tissue is the first to show degenerative changes, and it is Horner's contention that skull collapse as a result of brain collapse is the first of the skeletal changes to be noted after fetal death. This sequence seems to be well authenticated by numerous observers, but whether skull collapse to the point of overlapping of the skull bones takes place in all instances within a relatively short time after brain collapse is open to question. With newer and better roentgen technique it may be possible to demonstrate brain collapse in the absence of, or before, such overlapping takes place. There is, however, some question as to whether overlapping in itself is pathognomonic of fetal death. DeLee states that he has noted such overlapping in a living fetus, and we have noticed the same thing, as evidenced in the accompanying roentgeno-

gram (Fig 1) taken during studies on fetal cephalometry 3 days before labor occurred with delivery of a living child. The question, therefore, remains controversial, for in 1936 Horner stated "The fact nevertheless remains that overlapping of the skull bones is still the last word in the establishment of roentgen diagnosis of ante partum fetal death." We recently observed a case of fetal death *in utero* in our wards which seemed to show roentgen evidence of brain collapse in which no overlapping was demonstrable at any time.

The essential history may be thus summarized. A trigravida primipara was physically and subjectively well throughout her pregnancy, which was expected to terminate October 10, 1939. On October 19, 1939, she was seen in the prenatal clinic at which time she stated that she had not felt movement for the



Fig 1. Roentgenogram made 3 days before labor showing overlapping of skull in living fetus.

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Fig. 4. Roentgenogram showing no evidence of over-lepping or evidence of fetal death.



Fig. 5. Roentgenogram 24 hours after Figure 4 taken. Some changes noted in skull.



Figs 4 and 5. Case. The patient, 35-year-old tripara, entered hospital December 20, 1930, for suspected fetal death at about 16 months gestation. No movements felt by patient for several days and breasts said to be diminishing in size. Fetal heart and other usual sounds not heard. Roentgenogram shown in Figure 4, at left, taken December 20, 1930, that in Figure 5 taken December 24, 1930. Absolutely no change in position of fetal parts noted. One film may be exactly superimposed over the other. No significant skull changes noted. Stillborn macerated fetus expelled after medical induction.

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past 5 or 6 days. No fetal heart or movements could be demonstrated, and a peculiar silence was noted over the entire uterus. Fetal death was suspected and the patient entered the hospital for further observation. A flat film (Fig 2) of the abdomen taken at this time showed no evidence of overlapping or other changes which could be regarded as evidence of fetal death. Twenty-four hours later another similar film was taken which showed changes in the skull (Fig 3) as evidenced by depression or cupping of the anterior fontanel and a distinct change in the frontal suture line leading to the fontanel. In addition, the bones of the lower extremities and other portions of the fetal skeleton showed so little change in position that this film could be almost exactly superimposed over that taken 24 hours previously. Seventy-two hours after admission vaginal examination was done by the author in order to determine whether or not skull changes could be noted by this maneuver, but, although the cervix was 3 centimeters dilated, no evidence of overlapping or skull collapse could be noted. At this time the membranes were ruptured artificially and 24 hours later the patient spontaneously expelled a stillborn fetus which showed signs of maceration.

In further discussion of this subject it seems evident that at the present time there is no definite roentgenological procedure which in all cases can be considered pathognomonic of fetal death *in utero* within a first week after this event has taken place. Recognizing the fact that brain collapse is an early change, our attention should be drawn to the consideration of this change in viewing roentgenograms. It may be that serial roentgenograms taken at 24 hour intervals, with particular study of the fontanels and sutures, may give suggestive information concerning brain collapse, as in the case here cited. In addition, *serial roentgenograms may give evidences of a lack of spontaneous fetal movement as likewise noted*.

Finally, the well known clinical signs of fetal death should be thoughtfully interpreted in all cases, for here as in other fields of medical investigation roentgenological evidence serves as an adjunct which is both useful and important to diagnostic skill.

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# THE INFLUENCE OF HOT AND COLD APPLICATION UPON GASTRIC AND INTESTINAL MOTOR ACTIVITY

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FROM time immemorial hot and cold applications have been utilized in the treatment of certain lesions and functional disturbances of the gastro-intestinal tract. These applications are made directly through the fluids ingested and through those used for irrigation of the stomach and bowel and indirectly by the external application of hot and cold packs. As generally employed, ice is given by mouth and applied externally in cases in which a sedative or inhibitory effect upon gastro-intestinal motor and secretory activity is indicated and hot drinks, irrigations, and compresses are administered when stimulation is desired. To examine the validity of this concept the physiological investigation herein reported was carried out.

These studies represent a continuation of some previously reported (2). As in the previous studies continuous kymographic recordings were made of gastro-intestinal motor activity. These recordings registered the variations in pressure within the stomach and bowel resulting from tonus and peristaltic contractions of these organs during a period of observation.

Rubber balloons (on Miller Abbott tubes) were introduced into the stomach through the esophagus, into the small bowel via the esophagus and ileostomy stomas and into the large bowel through colostomy openings. Variations of pressure upon these inflated balloons were transmitted to ink-writers through U tube manometers containing bromoform. The apparatus with a balloon in the ileum passed through an ileostomy stoma is shown in Figure 1. All records of the stomach and small bowel were made upon essentially normal individuals, those of the colon upon patients who had had resections of rectal carcinomas from 1 year to several weeks previously.

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All studies were made while the gastro-intestinal tract was in a state of fast. The experimental procedure in each instance consisted of a preliminary recording of normal peristaltic activity over a period of 30 minutes or more. As soon as a consistent normal record had been obtained each of the following influences were brought to bear at successive periods of observation: (1) the abdominal wall was completely covered with hot water bottles for 30 minutes, (2) the abdominal wall was covered with ice bags for 30 minutes, (3) both thighs were covered with hot water bottles for 30 minutes, (4) both thighs were covered with ice bags for 30 minutes, (5) hot water was administered orally, (6) iced water was administered orally. The effect of these various influences will be discussed under their respective headings. Periodically during the period of recording of gastric motility samples of gastric contents were aspirated and analyzed for acidity. These findings are recorded in Table I. Three samples were taken from each patient. The first one was taken immediately before the application of the pack and the other two 10 and 60 minutes following the application.

Complete series of records of responses of the stomach were obtained in 8 patients, of the small bowel in 6 and of the colon in 4. Since the individual responses in each group were consistent in respect to pattern and varied only in degree they will be discussed collectively in terms of the response typical of the organ and the experimental factor.

1. Hot packs applied to the abdominal wall had an inhibitory influence upon gastric motor activity. For a period of 5 to 10 minutes following the applications there was no change. Then followed a reduction of tone and of both frequency and amplitude of peristalsis. This inhibitory influence lasted from 20 to 45 minutes. Samples of gastric

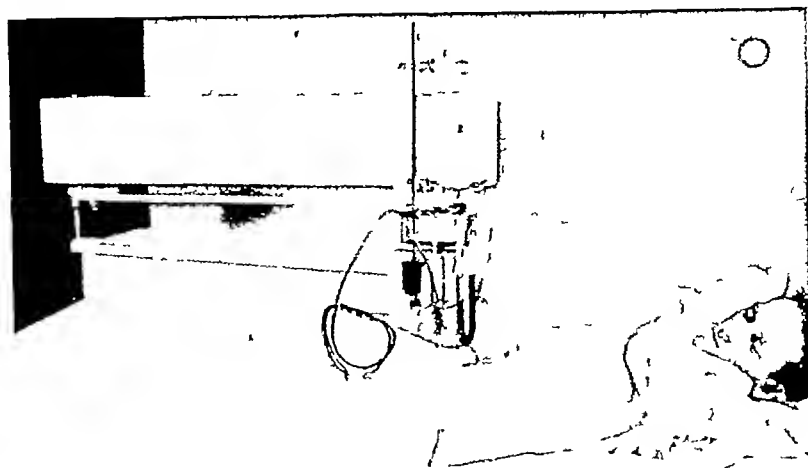


Fig 1 Patient with an ileostomy The tube emerging from the stoma connects an inflated balloon within the ileum to the U tube manometer An identical tube and balloon are displayed on the sheet across the patient's thighs Pressure changes within the bowel are transmitted from the balloon to the ink-writer through the U tube The ink-writer records the pressure changes upon the kymographic drum.

juice were obtained for analysis from 6 of the 8 patients These analyses showed no appreciable change in the acidity For the individual figures see Table I

Both small and large bowel showed the same inhibitory response, also a slight lessening of tone The response appeared after an interval varying from 5 to 10 minutes during which time peristalsis continued unchanged or showed slight stimulation The inhibition lasted from 15 to 40 minutes Illustrative records are shown in Figure 2

2 Ice packs, applied by covering the abdominal wall with ice bags, caused vigorous motor responses in all 3 segments of the gastro-intestinal tract This response in each instance was preceded by a period of normal activity lasting from 4 to 18 minutes The subsequent periods of increased activity varied from 20 to 50 minutes and the stomach showed the longest and most vigorous response Representative tracings appear in Figure 3

Samples of gastric contents were obtained from 5 patients In 1 patient who had an achlorhydria there was no change but in the 4 others there was a rapid and big increase in both free and total acids The figures for the individual analyses are recorded in Table I

3 The difference in the response to hot and cold applications was shown strikingly by the alternate application of these thermal agents

In this group of experiments hot packs were applied to the abdominal wall for 30 minutes and records obtained during this period and

TABLE I — GASTRIC ACIDITY

Hot packs to abdomen				Cold packs to abdomen		
Cases	Before	After	Net change	Before	After	Net change
1	10-30	14-35	4-5	14-35	38-60	24-25
2	30-45	35-50	5-5	14-34	39-58	25-24
3	0-10	0-10	0-0	0-8	0-10	0-2
4	18-32	24-36	6-4	14-30	33-88	24-58
5	28-48	25-48	3-0	30-52	43-95	18-43
6	22-32	22-30	0-1			

Hot packs to thighs				Cold packs to thighs		
Cases	Before	After	Net change	Before	After	Net change
1	14-36	10-36	4-0	17-40	36-59	19-19
2	32-50	3-56	5-6	8-45	42-80	14-35
3	0-5	0-6	0-1	0-6	0-6	0-0
4	10-1	18-41	8-0	14-38	36-86	2-43
5				24-40	42-92	18-52

Case 3 patient with achlorhydria also showed no response to his tamme.

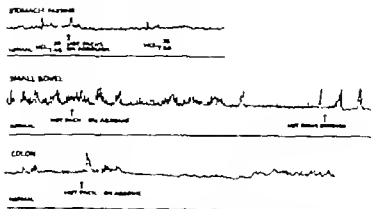


Fig. 2. Recordings of motor activity of the stomach, small bowel, and colon before and after covering the abdominal wall with hot bottles. After an interval of 5 to 10 minutes, tone became slightly diminished and peristalsis greatly inhibited in all three segments. Note that the acidity of the gastric contents remained unchanged.

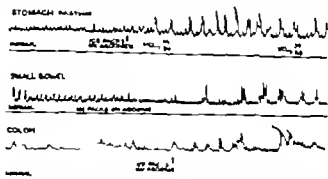


Fig. 3. The application of ice bags to the abdominal wall produced vigorous motor responses in stomach, small bowel, and colon, as indicated by increase in tone and in the amplitude and duration of contractions. Note that these responses did not come on immediately but followed latent intervals varying from 5 to 15 minutes. Also note the big increase in gastric acidity.

For 10 minutes following removal of the packs. Ice bags were then applied and the recording continued for another hour. Records of this type were obtained in 5 patients, the stomach in 3 and the colon in 2. In each instance inhibition followed the application of hot packs after a latent interval of 5 to 10 minutes. Almost immediately following the application of ice packs both stomach and colon still inhibited from the hot packs, showed fairly vigorous motor responses. These motor effects lasted as long as 60 minutes.

Gastric analyses were made in 2 cases and both showed no change in free and total acids

during the period of hot application but very marked increases following the application of ice. See Table 1 and Figure 4.

4. The influence of repeated applications of hot and cold packs to the abdomen was studied and it was found that the original responses were repeated. As reported both inhibitory and motor influences terminate after intervals of 20 to 60 minutes. Clinically these therapeutic thermal agents are continued over periods of several hours or days, either at constant temperatures or more often at the varying temperatures resulting from reapplications. For this reason the influence of the sec-

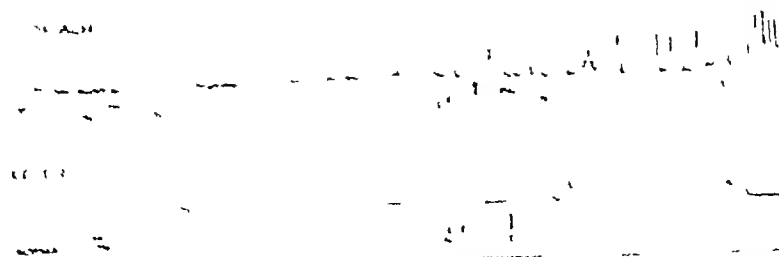


Fig. 4. The effect of the heat upon the stomach and colon following external hot application. A hot pack of ice was applied immediately following removal of the hot pack. Note that the inhibitory response to the hot application was converted almost immediately to a motor response to cold. Note also that gastric acidity remained unchanged during the application of heat and increased greatly following the application of cold.

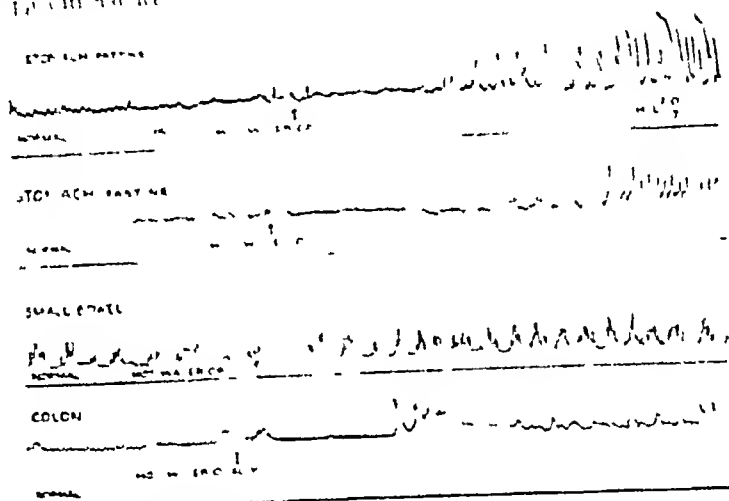


Fig. 5. Hot water taken by mouth caused a vigorous motor response in the stomach and definite but less vigorous stimulation of the small bowel and colon. The periods of increased activity were preceded by intervals of inhibition lasting from 5 to 20 minutes.

and applications of hot and of cold packs an hour after the effects of the first applications had been dissipated was determined. Recordings were made of the stomach, small bowel and colon during re-application of hot packs in 2 patients and of ice packs in 1 patient. As in the cases of the first applications heat inhibited and cold increased motor activity. These second responses, however, were lesser in degree and shorter in duration.

5. Hot water (6 ounces) administered by mouth had a pronounced motor effect with increase of both tonus and peristalsis along the entire gastro-intestinal tract. The motor effect became apparent after a period varying from 5 to 15 minutes during which period peristalsis

either continued unchanged or was slightly inhibited (Fig. 5).

Gastric analyses in the 3 patients from whom samples were obtained showed a moderate reduction of both free and total acids, presumably the result of dilution. There was, however, less reduction of the acids than in the patients given iced water.

6. Iced water (6 ounces) given by mouth had a slight but definite inhibitory effect upon the stomach and small bowel lasting from 10 to 30 minutes. After this period of inhibition peristalsis became normal or slightly exaggerated. The colon showed no definite response. Gastric acidity was reduced in the 4 patients from whom samples were obtained.



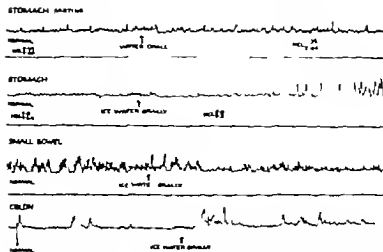


Fig. 6. The administration of ice water by mouth had little or no effect upon gastro-intestinal activity. Not that gastric acidity was decreased, the result presumably of both dilution and inhibition.

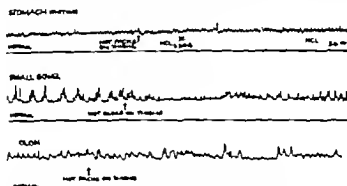


Fig. 7. The application of hot water bottles to both thighs had no appreciable effect upon gastro-intestinal activity and none upon gastric acidity. The small bowel shows some inhibition.

Presumably this was more than would result from simple dilution from water drunk. Sample records are shown in Figure 6.

7. The application of hot water bottles to the thighs had no effect upon the colon. There was a slight inhibitory influence lasting from 3 to 10 minutes upon the stomach and small bowel (Fig. 7).

Gastric analysis in 4 cases showed no appreciable increase in free or total acids.

8. Ice bags applied to the thighs had no effect upon the colon and had either no or only a slight, motor effect upon the small bowel. The stomach in all but 2 instances mani-

fested a moderate to vigorous motor response.

In 5 cases the motor response was preceded by an immediate inhibitory one lasting from 3 to 5 minutes. These motor effects lasted from 25 to 45 minutes. Typical records appear in Figure 8.

Studies of the gastric contents were made in 5 patients and in all but 1 there was a sharp rise in both free and total acids (see Table I). The patients who developed no increase in acidity had an achlorhydria and interestingly also there was no appreciable motor response. The recording from this patient is shown in Figure 9.



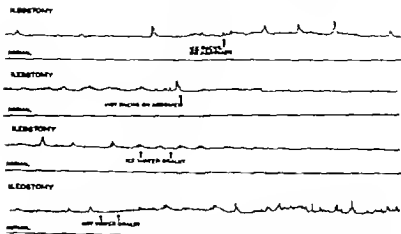


Fig. 2. Recordings of the motor activity of the ileum of the patient shown in Figure 1. Ice applied externally stimulated and taken internally inhibited peristalsis and tone. Hot applications had the reverse effects.

like substance. The stimulating effect of histamine upon gastric secretions is well established and utilized clinically. Thus it may be possible that the increase in gastric acidity following the application of ice resulted from histamine liberated by this application.

In using the terms motor and inhibitory to describe the reactions to hot and cold we appreciate the fallacy in making such a simple interpretation of the pressure changes exerted upon the balloons. These pressure changes are determined not only by the contractions of these organs but also by the patency of the sphincters. For this reason we are now investigating the effect of hot and cold applications upon sphincter tonus. Observations of this type have been made by Todd. In his studies of gastric motility by fluoroscopic observation he found that both hot and cold drinks of milk increased the frequency and vigor of peristaltic waves. Stimulation, however, was greater and much more prolonged with hot than with cold milk—20 minutes with hot and only 5 to 10 minutes with cold. Also with hot milk the opening of the pylorus was more frequent and more prolonged.

Carlson, using balloons to study hunger contraction in both man and dogs, found that iced water taken by mouth diminished gastric tonus and inhibited hunger contractions but that cold applied externally stimulated contractions. This stimulation however was pre-

ceded by a brief period during which there was either no effect or an inhibitory one. Werts and Sterkel and Carlson found that exposure of the naked human body to temperatures of 4 to 10 degrees Centigrade provoked a motor response in the stomach. Jaworski observed in man and Schule and Mueller in dogs, a reduction of tonus and peristalsis following the ingestion of iced water. Atkinson reported that ice placed directly upon the abdominal wall of dogs caused a decrease in gastric tonus and peristalsis.

With the exception of this latter reference all observations reported above are consistent and are in agreement with our findings. That this discrepancy is probably more apparent than real has been demonstrated by the studies of Sato. Using rabbits he recorded the intra-gastric pressure changes exerted upon indwelling balloons as a result of external applications of ice. He found that the gastric response was dependent upon the depth in the tissues to which the lowering of temperature was carried by conduction. If the cooling effect of ice did not extend deeper than the abdominal wall the stomach showed a motor response but if it extended to the wall of the stomach itself its motor activity became inhibited. Thus the same inhibitory action is produced by the actual cooling of the stomach whether indirectly by conduction through the abdominal wall or directly by contact with cold fluids.

administered by mouth. However, it seems extremely unlikely that the cooling effect of ice bags as used clinically ever extends deep enough to involve the wall of the stomach.

In an attempt to determine the *modus operandi* of cold applications Sato repeated his studies upon three groups of rabbits, in the first, both vagi were sectioned, in the second, the celiac and superior mesenteric ganglia were excised, and in the third group, the spinal cord was divided at the level of the second thoracic vertebra. Cooling of the abdominal wall in the first group had a very slight inhibitory effect, in the second group a pronounced motor effect, and in the third no effect. In all 3 groups, however, cooling of the wall of the stomach caused a decrease in tone and peristalsis. From this evidence he concluded that the motor responses to the application of ice result from the action of somatic stimuli upon the parasympathetic and sympathetic innervations of the stomach whereas the inhibitory responses result directly from the cooling of the tissues of the wall of the stomach.

The results of our investigation, we believe, provide some physiological data which can be used as a basis for guidance in the proper uses of hot and cold application. Some of the evidence is conclusive and its clinical application definite. For example, if it is beneficial as is generally believed that the gastro-intestinal tract be inhibited and placed at rest in so far as possible in the presence of inflammatory lesions such as appendicitis and peritonitis and of bleeding lesions such as bleeding peptic ulcers, then hot application and not ice bags are indicated. In these conditions the motor effect of the cold applications which are so commonly employed may be definitely deleterious. In the case of peptic ulcers the increase in gastric acidity following the application of cold is also undesirable and a possible contra-indication. In respect to the treatment of bleeding peptic ulcers the temperature of fluids administered by mouth deserves consideration. Disregarding the controversy between those who advocate complete starvation and those who feed patients with actively bleeding ulcers, attention is directed to the evidence that iced fluids cause greater reduction of gastric acidity than hot ones and have little or no effect upon

peristalsis. In addition cold produces vasoconstriction, theoretically a possible virtue in these cases. Certain clinicians lavage bleeding stomachs and for the same reasons enumerated, it would appear that the solutions used should be cold and possibly iced.

From the physiological data which has been presented it appears that ice packs would be more effective than hot application for purposes of expelling gas and relieving distention and that cold water by mouth would cause less gastric disturbance than warm water in recent postoperative cases. The physiological problem in this group, however, differs from that in the preceding one in one important aspect, namely motility. The movement of gastric and intestinal contents involves factors in addition to those studied in this investigation. It involves the proper integration of motor activity in the adjacent segments of the stomach and bowel and of their sphincters. It is well established that peristalsis regardless of vigor is ineffectual when disorganized. In the normal process of both segmental and mass movements of intestinal contents, the various segments of bowel contract and relax alternately in well integrated fashion. As a given segment contracts and expels its contents the adjoining distal segment relaxes to receive it. Failure of this distal segment to relax not only interferes with the normal movement of intestinal contents but also gives rise to cramp-like pain (gas pain). Thus under these circumstances the increased peristaltic activity resulting from cold applications might serve only to aggravate the disturbance and increase the patient's discomfort. Conversely, hot compresses by virtue of their inhibitory effect may be more conducive to co-ordinated action. Clinically, hot applications are definitely more effective than cold ones for the relief of colicky pain. But it is our impression, based upon recent comparative clinical observations, that cold applications are more effective in relieving distention.

In regard to the first fluids taken by mouth by postoperative patients we have observed no difference in the response to temperatures of cool and warm except that cool fluids are more palatable. However, iced water has been definitely less well tolerated.

## CONCLUSIONS

1. Gastro-intestinal motor activity is inhibited by the application of heat to the abdominal wall and by iced water taken by mouth. It is stimulated by the application of ice to the abdominal wall and by the ingestion of hot water by mouth.

2. External cold applications increase gastric acidity increasing both free and total acids. In a subsequent publication it will be proposed that this response be utilized in the test for true achlorhydria. By simply immersing the hands in iced water for a few minutes a response similar to that resulting from the subcutaneous injection of histamine can be obtained.

3. The ingestion of iced water diminishes the secretion of acids by the stomach.

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# CANCER AND ITS RELATIONS TO PREGNANCY AND DELIVERY, TO MARITAL AND SOCIAL STATUS

## II Cancer of Organs Other Than Reproductive, Total Cancer Mortality

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**D**IVIDING the male population of England and Wales into 5 social classes, Stevenson (1928) found an inverse change between the social position and the mortality rates from cancer of the skin, nose, pharynx, larynx, esophagus, and stomach, whereas the mortality from cancer of all other parts of the body remained unaffected. These parts were therefore supposed to be "inaccessible" to external irritants. That conclusion was broadly confirmed in 1938 by the analysis given for the years 1930-1932 by Stocks. The same results proved valid also for women. The difference in rates between accessible and inaccessible organs is the more surprising since it is a well known fact that the "inaccessible" lungs, urinary bladder, liver, and bones, are very likely to be affected by certain occupational risks.

By analyzing the cancerous reactions of the uterus, ovaries, and breast on the basis of social and biological conditions we learned of responses which counterbalanced one another. Therefore, the cancer totals for all the reproductive organs taken together showed very little of these organ-specific reactions. The situation regarding inaccessible organs is entirely different, none of them clearly is influenced by the differences in social level. However, one must distinguish between the kind of social grading applied here (e g , social class) and the social grading in general.

*The marital status and cancer of the accessible and inaccessible organs.* The marital status implies a social grading in itself. This grading reveals differences in cancer mortality. Widows show a higher incidence of cancer of the stomach than do married women, and married

women have higher rates than spinsters. Other accessible organs such as the skin and lip, mouth, pharynx, and esophagus, do not show any definite or outstanding trend. The so called inaccessible organs however display differences according to the marital status. In the age groups above 54 these differences are not smaller than those shown for the total of accessible or for the total of the reproductive organs. Widows again have the highest and spinsters the lowest rates, the differences being highly significant (Table I). The differences in rates between single persons and widows are greater than those between the first and fifth class. Therefore, factors other than social status must account for these differences.

Some of the differences are due to the relationship between reproductive activity and cancer of the gall bladder. Of the women suffering with gall-bladder disease there are fewer oligoparae and a greater number of multiparae than will be found in the women with cancer of the cervix (Peller and Stoehr). As to cancer of the biliary system, the rates for widows do not differ from those for married women but those for both are significantly higher than for single women (age groups above 55) (Table II).

In compiling statistics regarding the inaccessible organs it is cancer of the biliary system that brings the rates higher for married women over 54 years of age than for spinsters, and it is cancer of the colon and pancreas that reduces the rates for married women over widows. The differences in the rates for cancer of the colon are significant, the rates for the rectum, for the urinary and respiratory organs, for the thyroid, the brain, and the bones show no differences as regards widows and married or single women (Tables III and IV).

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## CONCLUSIONS

1 Gastro-intestinal motor activity is inhibited by the application of heat to the abdominal wall and by iced water taken by mouth. It is stimulated by the application of ice to the abdominal wall and by the ingestion of hot water by mouth.

2 External cold applications increase gastric acidity increasing both free and total acids. In a subsequent publication it will be proposed that this response be utilized in the test for true achlorhydria. By simply immersing the hands in iced water for a few minutes a response similar to that resulting from the subcutaneous injection of histamine can be obtained.

3 The ingestion of iced water diminishes the secretion of acids by the stomach

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# CANCER AND ITS RELATIONS TO PREGNANCY AND DELIVERY, TO MARITAL AND SOCIAL STATUS

## II Cancer of Organs Other Than Reproductive, Total Cancer Mortality

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**D**IVIDING the male population of England and Wales into 5 social classes, Stevenson (1928) found an inverse change between the social position and the mortality rates from cancer of the skin, nose, pharynx, larynx, esophagus, and stomach, whereas the mortality from cancer of all other parts of the body remained unaffected. These parts were therefore supposed to be "inaccessible" to external irritants. That conclusion was broadly confirmed in 1938 by the analysis given for the years 1930-1932 by Stocks. The same results proved valid also for women. The difference in rates between accessible and inaccessible organs is the more surprising since it is a well known fact that the "inaccessible" lungs, urinary bladder, liver, and bones, are very likely to be affected by certain occupational risks.

By analyzing the cancerous reactions of the uterus, ovaries, and breast on the basis of social and biological conditions we learned of responses which counterbalanced one another. Therefore, the cancer totals for all the reproductive organs taken together showed very little of these organ-specific reactions. The situation regarding inaccessible organs is entirely different, none of them clearly is influenced by the differences in social level. However, one must distinguish between the kind of social grading applied here (e.g., social class) and the social grading in general.

*The marital status and cancer of the accessible and inaccessible organs.* The marital status implies a social grading in itself. This grading reveals differences in cancer mortality. Widows show a higher incidence of cancer of the stomach than do married women, and married

women have higher rates than spinsters. Other accessible organs such as the skin and lip, mouth, pharynx, and esophagus, do not show any definite or outstanding trend. The so called inaccessible organs however display differences according to the marital status. In the age groups above 54 these differences are not smaller than those shown for the total of accessible or for the total of the reproductive organs. Widows again have the highest and spinsters the lowest rates, the differences being highly significant (Table I). The differences in rates between single persons and widows are greater than those between the first and fifth class. Therefore, factors other than social status must account for these differences.

Some of the differences are due to the relationship between reproductive activity and cancer of the gall bladder. Of the women suffering with gall-bladder disease there are fewer oligoparae and a greater number of multiparae than will be found in the women with cancer of the cervix (Peller and Stoehr). As to cancer of the biliary system, the rates for widows do not differ from those for married women but those for both are significantly higher than for single women (age groups above 55) (Table II).

In compiling statistics regarding the inaccessible organs it is cancer of the biliary system that brings the rates higher for married women over 54 years of age than for spinsters, and it is cancer of the colon and pancreas that reduces the rates for married women over widows. The differences in the rates for cancer of the colon are significant, the rates for the rectum, for the urinary and respiratory organs, for the thyroid, the brain, and the bones show no differences as regards widows and married or single women (Tables III and IV).

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TABLE I.—ENGLAND AND WALES, 1930-1932. CANCER MORTALITY OF WOMEN BY AGE, MARITAL STATUS AND ACCESSIBILITY\* OF THE ORGANS

Age	15—	25—	35—	45—	55—	70—
Number of women living in 1931						
Spinsters	805	273	43	308	200	131
Married	2,000	2,220	2,047	2,211	2,200	2,277
Widows and divorced		20	205	420	26	250.1
Cancer of accessible organs						
a. Number of deaths						
Spinsters	77	24	450	720	422	300
Married	200	71	187	2006	13	2013
Widows and divorced		64	207	266	137	212.1
b. Death rates from cancer of all accessible organs (per 100,000)						
Spinsters		8 ±	25 ±	70 ±	244 ±	150 ±
Married		10 ± 0.4	22 ±	22 ±	28 ±	253 ±
Widows and divorced		6 ± 0	40 ±	60 ± 7	± 7	200 ±
Death rates from cancer of the stomach						
Spinsters	0	4.0		20 ± 6	200 ± 6	100 ± 6
Married			0.1	02 ±	20 ± 2	200 ±
Widows and divorced	0			0 ±	247 ±	17 ±
c. Cancer of inaccessible organs†						
Number of deaths						
Spinsters	150	266	877	1,220	87	2006
Married	207	2277	2,007	2,277	2077	2,277
Widows and divorced		20	62	24	2127	2720
b. Death rates from cancer of the inaccessible organs						
Spinsters		± 0	64 ± 0.4	720 ±	266 ± 0	477 ±
Married	0	±	27 ±	22 ±	277 ±	477
Widows and divorced		27 ±	68 ±	200 ±	266 ± 0	400 ±

\*Stom. includes all parts of the stomach including the pylorus, antrum, and duodenum.

†All other digestive organs, the respiratory organs, kidney and bladder the thyroid, the breast, the bones including the jaw and unossified organs.

## MORTALITY ACCORDING TO MARITAL STATUS

In our calculations in the age groups above 54 years spinsters have higher rates for cancer of the reproductive organs than do married women and lower rates for cancer of accessible and inaccessible organs. Thus, in spite of the considerable differences in rates between single and married women as regards the various organs—the cervix and body of the uterus, the ovaries, breast, and gall bladder—the figures representing the total cancer mortality reflect very little of these differences.

Comparing the death rates from cancer for single women and widows the latter in all age groups is significantly higher. In younger women the differences are almost entirely due to the lower frequency of cancer of the reproductive organs. In older women the differences in rates are considerable for cancer of the accessible as well as of the inaccessible organs.

With the exception of the age group 25 to 34 years the cancer mortality rates are lower for married women than for widows but the latter have a significantly higher rate for cancer of

# PELLER RELATIONSHIP BETWEEN CANCER AND PREGNANCY

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TABLE II—ENGLAND AND WALES, 1930-1932 MORTALITY FROM CANCER, BILIARY SYSTEM

Age	25—	35—	45—	55—	65—	70—
1 Number of deaths						
Spinsters						
Married	12	38	108	175	121	250
Widows and divorced	28	121	447	930	515	704
		11	70	345	443	1639
2 Mortality per 100,000						
Spinsters						
Married	0.4	2.2	8.3	19±1.4	37±3.3	62±3.7
Widows and divorced	0.4	1.8	7.8	25.5 } 25.7±0.7	54 } 55±1.7	91 } 92±2.7
		2.3	7.6	26.1 }	56 }	93 }

TABLE III—ENGLAND AND WALES, 1930-1932 MORTALITY FROM CANCER OF SMALL INTESTINE, COLON AND OF PANCREAS, BY AGE AND MARITAL STATUS

Age	35—	45—	55—	65—	70—
1 Number of deaths					
a Spinsters					
Intestine					
Pancreas	118	245	428	291	706
b Married					
Intestine	18	46	95	72	122
Pancreas	333	9.5	15.1	837	1240
c Widows and divorced					
Intestine	6	107	404	185	19
Pancreas	28	225	793	856	3603
	3	55	163	176	453
2 Mortality per 100,000					
a Spinsters					
b Married	7.8	23.2	56.9	110.3	182.7
a and b	5.9	19.6	54.3	106.8	189.2
c Widows and divorced	6.3	20.2±0.5	54.6±1.1	107.6±2.9	186.8±3.0
	6.9	30.6±1.8	72.3±2.3	130.3±4.0	234.6±3.6

the reproductive as well as for the accessible and inaccessible organs (Table V, Fig 1)

## CANCER ASSOCIATED WITH PREGNANCY AND/OR CHILDBIRTH

The frequency with which cancer appears in pregnant women is unknown. According to the gynecological literature, in 10,000 pregnant women 4 to 6 cases occurred. Provided this figure is correct, in England in 1931 the incidence should have been cancer in 252 to 378 women,<sup>1</sup> whereas according to age specific cancer rates for total population the expectancy should have been only 141.7 such cases.

<sup>1</sup>632,000 births were registered

Yet according to the Registrar General in 1931 there were reported 14 cases and, in the 10 year period 1926-1935, there were altogether 113 cancer deaths associated with pregnancy or childbirth. Taking these figures at their face value, the conclusion may be drawn from the gynecological reports that the association of cancer with pregnancy is about 18 to 26 times the expectation, while from mortality statistics the figure is only 1/12 of the expectation.

As the duration of illness due to fatal cancer is on the average 2 to 3 years, and as the duration of pregnancy including the puerperium is only about 10 months the associ-

TABLE IV.—ENGLAND AND WALES, 1930-1932. MORTALITY PER 100,000 WOMEN BY AGE AND MARITAL STATUS

Age	15—	25—	35—	45—	75—
Biliary system, pancreas, small and large intestine ( <i>without rectum</i> )					
Spontaneous	28	31	26	147	113
b. Married		27	30	150 ±	100
and b	2	25 ±	70 ± 2	17 ±	167 ± 4
d. Widows and divorced		23 ±	60 ± 2	150 ± 3	113 ±
2. All other inaccessible organs					
Spontaneous		24	22 ±	10	12
b. Married	10 ±	20	22 ±	14	277
and b	20 ± 0.4	21 ± 4	±	16 ±	179 ± 8
d. Widows and divorced	4 ±	29 ± 3	70 ± 2	±	164 ±

\*Rectum, caecum, sigmoid, peritoneum, omentum, mesenteric stem, larynx, lung, mediastinum, breast, thyroid, kidney, bladder, uterus, ovary, and others.

TABLE V.—ENGLAND AND WALES, 1930-1932. ALL CANCER DEATHS BY AGE, MARITAL STATUS

Age	15—	25—	35—	45—	65—	75—
1. Number of deaths						
Spontaneous	41	277	6,230	2,328	2,000	6,523
Married	1,219	4,476	34	12,602	6,271	10,111
Widows and divorced	00	14	6,234	2,379	2,664	76,754
2. Deaths per 100,000						
Spontaneous	2	66	19 ±	16 ± 3	6.35 ±	64 ± 14.1
Married	16 ±	72 ±	200 ±	600 ±	670 ± 3	64 ± 2
Widows and divorced	16 ±	84 ±	646 ±	71 ± 2	84 ± 2	106 ± 3

ation of cancer with pregnancy and childbirth should be 2.4 to 3.6 times as frequent as that of the actually reported cancer deaths. The 14 fatalities from cancers reported in 1931 would therefore indicate an association of cancer with pregnancy about 3 times greater i.e. 42 cases, or 0.66 times in 10,000 pregnant women. The association of cancer and pregnancy reported by clinicians is 6 to 9 times higher than this figure.

The association of pregnancy and cancer is more probable at the beginning of the illness than in the later stages. Hence the mortality reports underestimate the likelihood of occurrence while clinical reports overestimate it as pregnant women suffering from cancer are more likely to attend the hospital than the average pregnant women.

As to the age factor in the occurrence of cancer deaths during pregnancy or at childbirth, the difference is smallest in the age group below 24 years, it is higher between 25 and 44 years of age and is at its peak in the age group between 35 and 44. The difference seems therefore to increase as age advances<sup>1</sup> and as the pregnancies increase (Table VI).

#### PARTURIENT HISTORY AND CANCER BY SITE

Cancer of the gall bladder is correlated with the parturient history therefore the figures brought out here are not surprising. The explanation of the other findings is less easy. According to former studies, the primary tumor as far as it depends upon the parturient history may be located in the uterus, the

No calculations could be made for the age group 45 to 60.

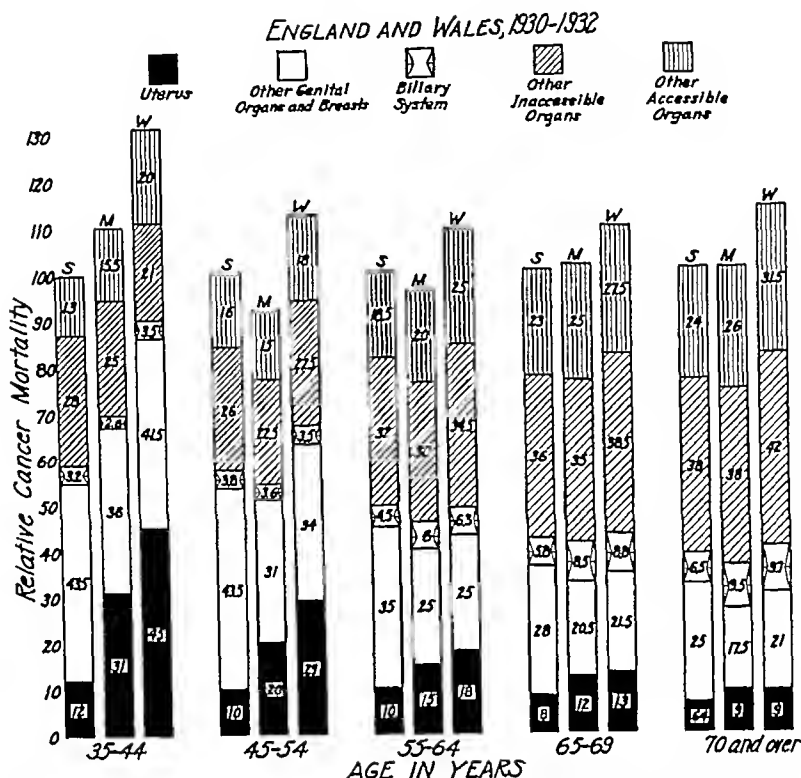


Fig. 1 Relative cancer mortality by site, age, and marital status in single (S), married (M), and widowed (W) women in England and Wales (1930-1932)

ovaries, the breast, and the gall bladder as well as in the stomach. It is not located in the intestines, however. In the total cases of cancer arising in the gastro-intestinal tract, in the biliary system, and in the reproductive organs, only those of the intestinal tract are not correlated with reproductive activity. There are, of course, no official mortality statistics which divide cancer victims according to their parturient history. Such data, however, may be obtained from representative clinical material and applied to official mortality statistics, which show the distribution of cancer by site in the female. I made a study of the pregnancy histories of 2,927 women above 45 years of age (Vienna University Clinics), 1,725 of them were suffering from cancer of the genital organs, 423 from breast cancer, 403 from cancer of the stomach, 280 from intestinal cancer, and 96 from cancer of the gall bladder. I applied the pregnancy data to the

1,395 women over 45 years old who died during 1928 in Vienna of cancer of one of these organs. Thus I estimated among deaths from cancer in the entire population the number of nulligravidae, of women with 1 to 3, with 4 to 7, and with 8 and more pregnancies. As shown in Table VII, when the cases are grouped according to the woman's parturient history the distribution of the primary malignancies varies. However, the ratio as to intestinal cancers remains almost unchanged, that is 17.7 per cent in the nulligravidae and 18.3 per cent in women with more than 7 deliveries (Table VII).

While these figures are only a rough estimate, there is no other material published which gives these relations. Table VII complements the analysis of the English mortality statistics. It is probable that the differences in rates for widows and the other women as far as cancer of the colon is concerned are due neither to the parturient history

TABLE VI—ENGLAND AND WALES ACTUAL AND CALCULATED ASSOCIATION OF CANCER DEATH WITH PREGNANCY OR CHILD BIRTH BY AGE

Age	a. Birth rate per 1000 women (1931)	b. Cancer death rate per 1000 women (1934-1935)	c. Expected association of pregnancy and total cancer per million women (a X b)	Actual association of pregnancy and cancer in 1934-35			Number of deaths reported	—
				Per cent	Per million women	Per thousand pregnant women		
—	12.36	0.903	0.3731 ± 0		4979 ± 46	0.45 ± 0.013		
10-14	20.82	0.117	0.0024 ±	3	1138 ± 46	0.015 ± 0.0010		
15-19	95	0.156	0.0147 ± 3		366 ±	0.017 ± 0.001		
20-24	91.13		0.009 ± 0.00		91 ± 11	0.005 ± 0.0016		
25	61.14	0.106	0.006 ± 0.01		9400 ± 46	0.3 ± 0.010		
25-34	24.7	0.04	0.0010 ±	5	715 ± 15	0.011 ± 0.0017		1

TABLE VII—VIENNA 1928 CANCER OF GENITAL ORGANS BREAST STOMACH INTESTINES AND BILIARY SYSTEM IN WOMEN OVER 45 DIVIDED BY THE NUMBER OF PREGNANCIES\*

Organ or part	Pregnancies				Total cases
	Pregnancies				
	1	2	3	4	
Cervix uteri		10	18		
Other genital organs					
Breast	3		10		
Stomach		16	10		
Biliary system					
Intestines					18
	100	100	100	100	

\* 394 total cancer cases

and standard of life nor to diagnostic errors. They should be traced rather to the reactions of the body incident to the loss of the *pater familias*. This circumstance in the carcinorelevant mechanism remains to be clarified.

## SUMMARY

1. *Marital status*. The total cancer mortality as well as the site of the primary tumor—genital organs, breast, stomach, biliary system, pancreas, and colon—is influenced by the marital status. During the age of reproduction married women show higher cancer rates than do spinsters in the 20 years following there

are small differences in favor of married women above the age of 64 both groups have about equal cancer mortality rates. These cases differ from one another only in the distribution of the primary tumors. In widows the age specific mortality rates are higher for cancer of genital organs, breast, stomach, pancreas, and colon than in single or married women. Widows also succumb more frequently to gall bladder cancer than do single women.

2. *Reproductive activity*. There is a correlation between reproductive activity and the changes in the cancer distribution within the genital organs, the breast, biliary system and stomach, the incidence increasing in some organs and in others diminishing. These changes counterbalance each other.

3. *Cancer and pregnancy*. The simultaneous occurrence of cancer with pregnancy seems less frequent than would be expected, the deficit increasing as age advances and as the average number of pregnancies increases.

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# CLINICAL SURGERY

FROM SURGICAL CLINIC, PROFESSOR DR JOSE ARCE, UNIVERSITY OF BUENOS AIRES

## RHINOPLASTY

### Argentine Method

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**T**HE Argentine method described in 1921 by Dr Oscar Ivanissevich employs the pinna with its skin and cartilage to repair loss of tissue in the soft parts of the nose, its tip and alæ. The pinna is transplanted by means of the thumb, as shown in Figures 1 to 13. Since 1921 the author and his collaborators have used this method 46 times. In Lima, Peru, Professor Fortunato Quesada operated upon 2 patients successfully and reports of these cases have been published.

Tissue from the ear has been chosen because of its similarity to the tissues of the soft part of the nose. The cartilaginous structure gives elasticity and toughness to the graft. The graft is so constructed that the skin of the mastoid area is used to cover the apex and the alæ. The skin of the outside part of the ear is used to form the nasal vestibule. The convex end of the helix, therefore, faces downward and outward.

The technique used in the transplantation resembles that of the Italian method and is carried out in two stages. In the first stage

(Fig 4) the pinna is sutured to the fleshy part of the thumb. This has to be done very carefully and in two planes. In the deep plane the periosteum of the third phalanx is fastened with thin catgut to the cartilage of the ear (Fig 13). In the superficial plane the skin edges of the ear are carefully sutured with silk to the skin of the finger.

Ten days later the skin sutures are removed and the circulation from the ear to the finger is intermittently interrupted, by means of continuous pressure tongs. For the first few days pressure is exerted for only 5 minutes and then gradually the interruption period is increased until pressure is applied for an hour by the twentieth day. If the digito auricular flap is large and cicatrization is normal, this period will be sufficient. When the graft does not change color upon interruption of the auricular circulation of blood, that is, when circulation in the graft has been established, then the propitious moment to sever the section from the ear has arrived.

In the second stage the pinna is divided at the level of the line upon which the continuous pres-



Fig 1

Fig 2

Fig 3

Fig 4

Fig 1 Outline of incision which is used for section of the auricle.

Fig 2 Turning of the tubercle flap.

Fig 3 Incision in fleshy part of thumb.

Fig 4 Digito auricular suture. The dotted line shows the line of future section.

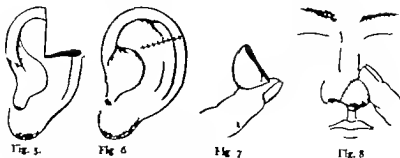


Fig. 5 Defect in ear after removal of flap.  
 Fig. 6 Shape of ear after suture of defect.  
 Fig. 7 Thumb with section of ear attached.  
 Fig. 8 The flap with finger still attached has been sutured to the nose.



Figs. 9, 10, and 11 Construction of the septum and the subseptum.

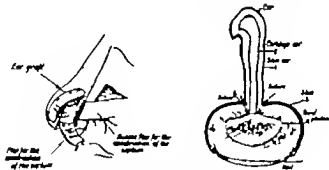


Fig. 12, left Final steps in construction of the septum and subseptum.  
 Fig. 13 Sectional view of finger attached to ear.

sure tongue has been placed and the finger with the piece of pinna attached is thus isolated (Fig. 7). It is now possible, depending upon circumstances, the age and tolerance of the patient, to proceed with the operation. The free end of the pinna flap may be sutured and cicatrization waited for or the second stage may be done immediately, that is the piece of ear attached to the finger may be fixed to the nose. The surgeon must decide what is best in the particular case.

Suture of the auricular flap to the nose after the stump is freshened is very easy and yet requires special care (Fig. 8). The suturing must be done in three planes: in the cutaneous plane of vestibule, the cartilaginous plane, and in an external cutaneous plane. The last suture is intradermic.

From the tenth day on interruption of circulation with the tongue is again carried out. Usually it is possible to separate the finger from the graft after 20 days.

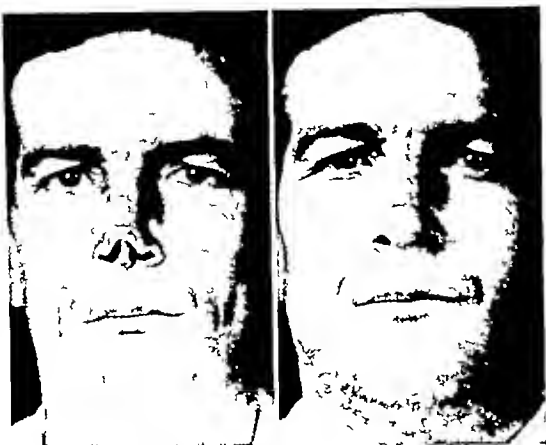


Fig 14, left. Cancer of the nose healed by radium  
Fig 15 Ivanissevich graft has been applied

After the finger is freed the surgeon may decide to join the free end of the graft to the nasal stump immediately or he may suture the free end and wait until cicatrization is complete. The decision depends upon the nutritional condition of the graft. Occasionally during this process as well as during the earlier stage of the operation, the skin of the graft may become edematous and brittle. In such cases it is best to act with caution and, before proceeding with the next stage, to wait beyond the 20 day period mentioned for both stages or until epidermization of the graft is complete.

The third stage consists in the final adaptation of the graft. No special description of technique is needed. The prime essential is great care in the suture which is best done in three layers.

The subseptum can be made from the skin of the inferior face of the auricular graft. On this skin a cutaneous trapezoidal flap of the inferior base is carved as shown in Figures 9, 10, 11, and 12. The skin is dissected up to the cartilage and the ends are sutured to the remaining piece of the nasal septum.

In some cases it is necessary to make some finishing touches, and in others complementary grafts are necessary.

**Immobilization apparatus.** The apparatus which we have used consists fundamentally of a leather glove which encloses the hand and wrist, and a set of ribbons which make it possible to fix the thumb in the best position in any of the stages during the process of digito-auricular suture and during the process of digital, auricular-nasal suture. Quesada has used an improvised apparatus of court plaster but we do not recommend



Fig 16 Section of ear attached to finger ready for application to nose

it. It is necessary that the apparatus be very firm so that displacements are reduced to a minimum. During the second stage the auricular-nasal suture, to insure immobilization of the thumb in restless patients we make a perforation in the free part of the nail and with a strong string we tie the nail to the head bandage. During the first few days the patient naturally suffers from the immobilization but he soon is relieved and is able to perform easy movements with the free fingers and massaging of the shoulder, the elbow and the forearm. Some patients can get up from bed and walk without any difficulty. In 2 cases the pa-



Figs 17 and 18 Front and lateral views of reconstructed nose shows perfect result



lients left the hospital the day of operation and went home. The personal factor here as in any other type of surgery is very important. In only one case did the graft become separated in the second stage but it could be sutured successfully again in 1 month.

*Repair of the ear.* The repair of the ear is simple when only a small amount of tissue is removed but a real operation is required when a large amount of tissue is removed. In the former case direct suture is sufficient for reconstruction of the pinna the ear appears smaller but is of natural form. If the amount of tissue removed is large repair may be accomplished by means of an autoplatic operation with skin from the mastoid region or with a tubular graft.

#### GENERAL RESULTS

Up to the present time we are unable to find reported results better than ours, no matter what method has been used. The Argentine method has already stood the test of time. Our first patient was operated upon 20 years ago. Photographs show not only the immediate result but the condition 20 years later.

Our experience in 46 cases makes it possible to speak with authority as to the merits of this method and to state that it gives the best results in the shortest time.

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# THE OPENING OF THE ANTERIOR TRACHEAL WALL IN TRACHEOTOMY

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**T**RACHEOTOMY is one of the oldest and most important of the surgical procedures and belongs to the general category of neck operations. It is not limited to any one specialty and should be mastered by the laryngologist, surgeon, and general practitioner. In spite of its being an old operation, failures still occur during the course of the operation and in the after-treatment. Some of these are due to the method of opening the trachea itself.

Historical evidence shows that the method of opening the trachea has varied from time to time. During former centuries operations involving incisions in the cartilages of the trachea were shunned because such a procedure was regarded as dangerous. Incisions were made instead between the cartilages through the intercartilaginous ligaments (Kuehn).

During the nineteenth century the so-called "classic method" came into favor. In this operation after exposure of the trachea below the cricoid cartilage, a longitudinal incision is made in the anterior tracheal wall through several cartilaginous tracheal rings and intercartilaginous ligaments. The incision is then pulled apart by small retractors or spread apart by a dilator and a cannula is inserted into the trachea through this opening. This became the operation of choice and the technique is still presented in many surgical and laryngological textbooks.

By this method, parts of the cartilaginous tracheal rings are spread apart, bent upon themselves and buckled in an unnatural position in order to furnish room for the cannula. The evils that result may complicate the healing of the wound and the process of decannulization. The principal objections to this method are:

- 1 The C shaped cartilaginous rings, which are open at the back and connected there only by the membranous wall of the trachea, are dislocated by the cannula. The pressure causes the soft membranous wall of the trachea to bulge forward toward the lumen of the trachea thus making it narrower (Fig 1b).

- 2 The cut edges of the elastic cartilaginous rings in front are bent by the pressure of the tube

and the frequent change of tube may result in a narrowing of the tracheal lumen (Fig 1d).

- 3 The cut edge of the split cartilaginous rings on which the tube is continuously rubbing undergoes inflammatory changes and becomes covered with granulations. The cartilage around the tube becomes soft, is easily destroyed, and later is replaced by connective and scar tissue. This latter tissue may contribute to the formation of stenosis. Even if no stenosis results, the anterior wall of the trachea may lose its cartilaginous support and, after removal of the tube, move in and out with each inspiration and expiration.

These disadvantages will be of a temporary nature and subside if the tube lies in position only for a short time. They become definite conditions if the tube is worn for a period of time with proliferation of connective and scar tissue. In addition there are minor difficulties when the tube is changed. The slit in the trachea lies at the bottom of a long funnel shaped wound and is accessible only with difficulty. Often the change of tube is liable to become an exciting experience for both the doctor and the patient.

Since the middle of the past century attempts have been made to eliminate the disadvantages of the slit incision method. Marshall Hall in England and Dieffenbach in Germany made the first fundamental change in the method by making, instead of the simple incision, an *excision* of a part of the anterior wall of the trachea. After opening the trachea, Marshall Hall introduced a piece of cork into it and used this as an underlying support, then with an iron punch and mallet he removed a round piece of the trachea. Dieffenbach removed a square piece of trachea amounting to two cartilaginous rings. American physicians, See and Donkoff at about the same time, tried to overcome the evils of pressure from the tube by cutting an opening into the anterior wall of the trachea and placing a silver wire in it.

It is interesting to note that while the excision method, though devised by leading surgeons of their respective countries, has not been given much consideration by surgeons, it has been accepted and improved by European laryngologists. Thost made it the method of choice and

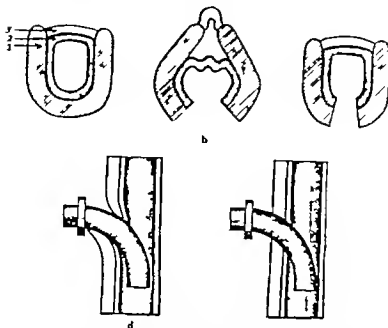


Fig. Transverse and longitudinal section of the trachea. (Modified from Thost.)  
 a, Normal trachea: c, cartilage; m, mucous membrane; a, posterior wall. b, Trachea after incision of anterior wall, note buckling of posterior wall. c, Trachea after removal of anterior wall, note posterior wall smooth. d, Tube inserted after incision, note displacement of anterior tracheal wall. e, Tube inserted after excision, not undisturbed anterior wall.

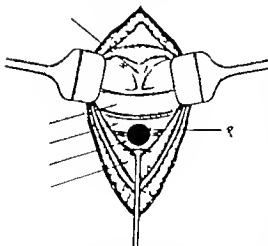


Fig. Tracheostomy with window resection in the anterior wall. C, first, second, and third rings of trachea; T, isthmus of thyroid gland; R, resected part of anterior wall.

the Viennese school of laryngology (Hajek and his immediate predecessors) used it advantageously.

It is obvious that laryngologists appreciated the great advantage of this method more than did surgeons. They observed, more diligently perhaps, the patients who wore the tubes over longer periods of time; they noticed the damage that was done by the tube and recognized the causes producing the damage and made attempts to avoid them.

They believed that pressure from the tube and displacement of the tracheal cartilages were the main causes of damage, and they observed that *excision* of a portion of the tracheal wall rather than a simple *incision* was far more satisfactory. This postulation had a sound mechanical basis. No plumber working with metal or rubber tubing would consider making a union or inserting a connection through a slit in the tube; they would cut a hole for the connection. This means that in a tracheostomy the *incision* must be replaced by an *excision*. A window is cut in the anterior wall of the trachea of sufficient size to accommodate the

tube to be inserted (Fig 2) When the tube is introduced the cartilages are not spread apart, not bulged forward from behind, nor pressed upon too much (Fig 1c) Neither destruction of, nor granulations on, the tracheal cartilages occurs Long years of experience have shown that resection of the piece from the anterior wall is harmless as regards later functioning of the trachea

The use of resection facilitates considerably the after-treatment and change of the tube The permanent opening usually makes dilatation a superfluous measure The level of the opening is of minor importance if one fundamental rule is observed, namely the cricoid cartilage must not be injured and under no circumstances must it be exposed to the pressure from the tube

The resection is performed customarily with forceps and small bent scissors If there is ossification of the cartilage this may be quite difficult Also if one does not perform a tracheotomy frequently some difficulty may be encountered in cutting out just the right amount to accommodate the tube The opening should be made as sharp edged as possible, the cartilage and the tracheal mucous membrane should be cut out precisely and sharply

To overcome these difficulties and to perform the resection more easily, I have devised an instrument, the manipulation of which is simple It has proved satisfactory in many tracheotomies (Fig 3) Without difficulty the instrument cuts the hardest rings together with the adherent perichondrium and mucous membrane The instrument makes the opening of proper size, clean and sharp edged, and automatically prevents the aspiration into the bronchi, of the excised piece of tracheal wall as it holds the piece intact until removed The principle embodied in the instrument is the result of many years of experience in this field of surgery It has recently been modified so that it will fit the American universal handle<sup>1</sup>

The resection thus is performed simply in the following way

After exposure of the trachea the membranous annular ligament between the second and third

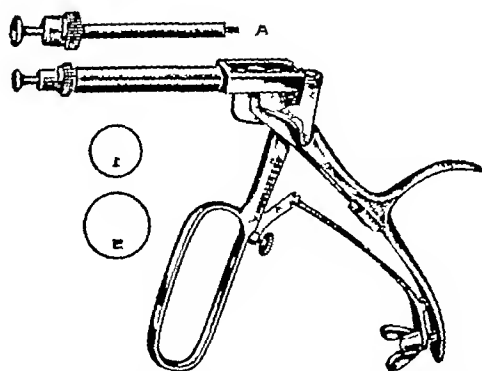


Fig 3 Instrument for performing the window resection in tracheotomy Exchangeable tip A showing variation in size for different age as is also depicted in the openings 1 and 2 for a child and for an adult. The instrument with tips is approximately one third natural size, 1 and 2 openings are normal size

tracheal rings is split transversely, the disc of the instrument is introduced into the slit, and the instrument is closed as is a conductor's punch It is removed and the excised piece of tracheal wall is contained therein By the opening thus produced the tube is passed easily into the trachea The entire procedure could not be simpler

It is the purpose of this discussion to present a method of performing tracheotomy which has proved satisfactory, and which avoids a number of rather untoward consequences I believe the method can be recommended wholeheartedly

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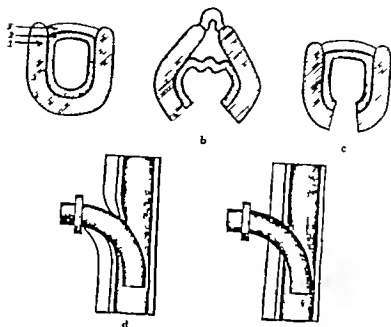


Fig. 1. Transverse and longitudinal section of the trachea. (Modified from Thost.)  
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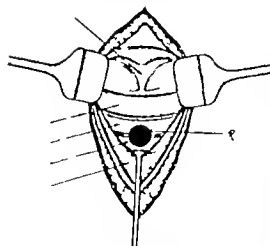


Fig. 2. Tracheostomy with window resection in the anterior wall. C, Cricoid; F, first, second, and third rings of trachea; T, isthmus of thyroid gland; R, resected part of anterior wall.

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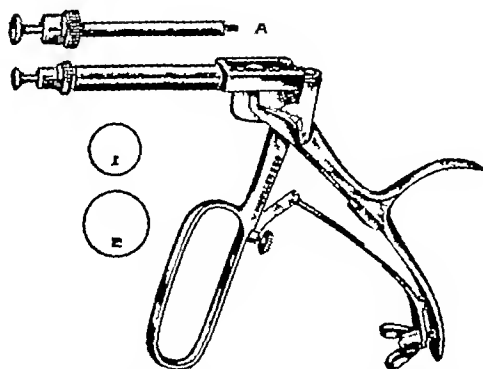


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# BILATERAL INTERCOSTAL NERVE BLOCK FOR UPPER ABDOMINAL SURGERY

ROBERT W BARTLETT M D St. Louis, Missouri

**A** VITAL problem confronting the surgeon daily concerns the proper choice of anesthesia for each individual case since every one of the numerous anesthetic agents and methods ordinarily employed possesses qualities which limit its usefulness.

Our own dissatisfaction with methods of anesthesia available to us for operations on certain seriously ill, jaundiced patients was the original stimulus for this study but as we have gone further with bilateral intercostal nerve block its usefulness has been found to cover a wide range in intra-abdominal and abdominal wall surgery.

But to return to the jaundiced patient requiring surgery we have tried whenever possible to avoid an ether anesthesia since by this method an additional load is thrown on a liver and kidneys already damaged. This, then has meant that spinal was probably the anesthetic of choice in these cases. However certain of these patients may present some of the standard contra indications to spinal anesthesia, such as marked anemia or extremes of blood pressure which preclude its use. Then too, if one is unfortunate enough to have a severe reaction follow the use of spinal anesthesia in an already seriously ill patient, the outcome may be disastrous. It is thus apparent that spinal anesthesia will often be unsuitable. Cyclopropane is proving to have a wide range of usefulness, but when employed in concentrations sufficient to produce the degree of muscular relaxation usually necessary for work on the common duct, the definite hazard of serious depression of vital functions exists.

Paravertebral nerve block anesthesia has never gained any considerable popularity because of the technical difficulties inherent in the method, the result being a failure to obtain proper anesthesia in too large a percentage of cases. The reader is referred to Hertzer for illuminating comments both on paravertebral and splanchnic anesthesia. In recent years Dogliotti and Odum (8, 9) have advocated epidural anesthesia for patients not suitable for spinal or general anesthesia, but here again, to quote the latter author "The skill and care necessary for administration of an epidural

anesthetic, coupled with the fact that one must wait 15 to 30 minutes for the onset of anesthesia, makes it probable that epidural anesthesia will not be used in busy hospital service.

It occurred to us that our problem could be solved by blocking the lower intercostal nerves in the midaxillary line so that their lateral branches could be included along with their anterior branches and thus would be obtained complete anesthesia of the anterior and lateral abdominal wall including the parietal peritoneum from the costal margin to approximately 3 inches below the umbilicus. In as much as sensation to the visceral peritoneum is by way of the splanchnics a light gas anesthesia must be given in conjunction with the nerve block during the intra-abdominal part of the operation in order that ordinary handling and packing off of intestines may be performed without pain to the patient and to this we have found no objection. In the past for operations in the upper abdomen it has been rather common practice to block the nerves by infiltrating along the costal margin and down the lateral border of the rectus muscle. The method we propose has several distinct advantages over the one just referred to due to the fact that the lateral flat abdominal muscles, namely the external oblique, internal oblique, and the transversus abdominis are paralyzed as likewise is the periphery of the diaphragm. As a result the ability of the patient to strain, as occurs during marked respiratory effort or vomiting, is minimized so that there is little tendency of the intestines to be pushed out of the wound during operation. Second accurate and rapid closure of the abdominal wall is obtained at the conclusion of the operation since the lateral muscles are paralyzed and not pulling the wound open as they do when only a circular infiltration about a rectus incision is performed. It is a corollary of this that postoperative hernia and eventrations are far less common when the peritoneum and posterior rectus sheath have been accurately approximated, thus avoiding defects in which the omentum can work its way. This kind of closure, of course, is possible only in the completely relaxed patient.

It is apparent, therefore, that by means of perfectly simple method of anesthesia we are able to

From the Department of Surgery Washington University School of Medicine

enjoy the advantages of a full ether or spinal anesthesia in the care of patients presenting definite contra-indications to those methods. As stated earlier in this paper, we were originally interested in obtaining a safer anesthesia for certain extremely sick jaundiced patients, but as time has gone on we have extended its use to include almost any surgical procedure required in the upper abdomen, also any work on the abdominal wall from about 2 inches below the umbilicus up to the costal margin. In this latter instance one may or may not, as one wishes, administer gas for 3 to 5 minutes while the intercostal injections are being made, then stop the inhalation and carry out the plastic procedure on the wall under the ensuing nerve block. We have been particularly pleased with the ease of repairing umbilical and incisional hernias and of closing colostomies in the transverse colon by this method in cases in which it seemed wise to avoid the possibility of a reaction to spinal anesthesia.

I recall a particular instance of eventration in which the method was perhaps life-saving. A husky, 6-foot, young adult male had been subjected to exploration through an upper right rectus incision for a stab wound of the liver following which he developed lobar pneumonia and the wound broke open on the fifth postoperative day, probably as a result of severe coughing. Bilateral intercostal nerve block was carried out after the skin was infiltrated, and, with the patient in bed in his own room, the wound was closed without difficulty by means of through-and-through silk-worm gut stay sutures. Following this the patient recovered from the pneumonia and the abdominal wall healed solidly.

The following operations have been performed under this method of anesthesia: exploration of common duct, cholecystectomy, cholecystostomy, cholecystogastrostomy, biopsy of liver, aspiration of liver abscess, closure of perforated typhoid ulcer, repair of incisional hernia, repair of umbilical hernia, closure of transverse colostomy, and secondary closure of abdomen after eventration.

We have had no failures to obtain anesthesia since the tissue planes through which the intercostal nerves pass are so very accessible in the mid-axillary line for blocking; further, we know that we can expect at least an hour and a half anesthesia according to the technique to be outlined since we did, on one occasion, require that much time for exploring a common duct and repairing an incisional hernia, the result of a previous operation elsewhere.

A thorough search of the literature, including standard textbooks on anesthesia such as those of

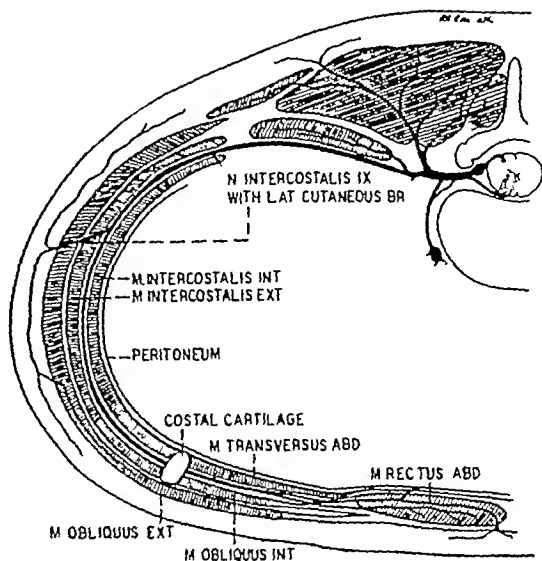


Fig 1 Typical distribution of a lower intercostal nerve to the abdominal wall

Labat, Hertzler, Farr, Gwathmey, and Flagg, discloses no plan of anesthesia for upper abdominal surgery bearing any very close similarity to the one we are proposing though many thoracic operations have been performed under intercostal block. Farr, in one of the many case reports in his book, simply makes the statement that a gastric resection was carried out under unilateral intercostal block in the nipple line from the fifth rib downward combined with transverse infiltration across the recti with a vertical limb in the midline plus anterior splanchnic anesthesia after the abdomen had been opened.

#### ANATOMY

According to Gray, the intercostal nerves pass forward (Fig 1) in the intercostal spaces below the intercostal vessels. At the back of the chest they lie between the pleura and the posterior intercostal membranes, but soon pierce the latter and run between the two intercostal muscles as far as the middle of the rib. They then enter the substance of the internal intercostals and run amidst their fibers as far as the costal cartilages. The seventh, eighth, ninth, tenth, and eleventh intercostal nerves then pass behind the costal cartilages and between the internal oblique and transversus abdominis to reach the sheath of the rectus abdominis which they perforate. They supply the rectus abdominis and end as the anterior cutaneous branches of the abdomen, they supply the intercostal and abdominal muscles. About



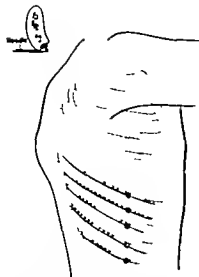


Fig. 2. A, Sites of injection of seventh, eighth, ninth, tenth, and eleventh intercostal nerves in midaxillary line. B, Nerve lying at inferior border of rib between external and internal intercostal muscles.

the middle of their course they give off lateral cutaneous branches. These pierce the external intercostals and the external abdominal oblique and divide into anterior and posterior branches which distribute to the skin of the abdomen and back. The anterior branches supply the digitations of the external abdominal oblique and extend forward and downward nearly as far as the margin of the rectus abdominis. The posterior branches pass backward to supply the skin over the lumbus dorsalis.

Thus it is apparent that the site of election for injection of the anesthetic agent is in approximately the midaxillary line where the nerve, lying at the lower border of the rib and between the two intercostal muscles, is most easily accessible and where the lateral cutaneous branch of the nerve supplying most of the external abdominal oblique muscle will be included in the block.

#### TECHNIQUE OF ANESTHESIA

Modern practice presupposes that the patient will arrive at the operating suite with an adequate basal anesthesia. Ethylene or any other suitable gas is then administered for 3 or 5 minutes so that the patient will not be aware of the ensuing needle pricks. During this time the arms may be abducted and the skin of the lateral chest wall on either side prepared from the level of the nipple to below the costal margin.

In view of the fact that one should allow approximately 10 minutes for any nerve block anesthesia to become effective it has been our custom to don sterile gloves and do the injections, then scrub while the anesthetic is taking hold, thus wasting no time.

We have been employing a per cent novocain solution with 3 minims of adrenalin to the ounce added in order to insure sufficient duration of anesthesia. As stated earlier we have not required more than an hour and a half thus far however should one foresee the probability of a more prolonged operation there are several longer acting drugs available for injection.

The seventh, eighth, ninth, tenth and eleventh intercostal nerves on each side are blocked in the midaxillary line (Fig. 2) starting from the lowest one and working upward. We use any suitable syringe and a No. 17 caliber needle with a point sufficiently blunt so that its passage through a fascia layer can be appreciated. We palpate the lower border of the rib and then the needle is passed through the skin and fat down to this point. Following this the needle is allowed to slip off the lower border of the rib. In so doing it is easily felt to pass through the fascia covering the external intercostal muscle. The needle point now lies between the two intercostal muscles at the costal groove where run the intercostal vessels and nerve. The injection of between 3 and 4 cubic centimeters of the anesthetic solution is quite sufficient for each nerve, thus with 5 sites of injection on each side a maximum of 40 cubic centimeters is employed.

If one person performs the bilateral block, about the same time is required as for administering a spinal anesthesia; however if the surgeon and his first assistant each do a side simultaneously, a matter of only 2 or 3 minutes is involved in this procedure.

As stated earlier a light gas anesthesia must be maintained during the intra-abdominal portion of the operation in order that intestines may be handled and packed off without pain and shock to the patient; however when one is closing the abdomen or performing a plastic operation on the wall such as repair of umbilical or incisional hernia, the gas may be dispensed with as soon as the nerve block has become effective. As an alternative method, the block may be performed under local instead of gas if the operation is to be confined to the abdominal wall; then, too, there may be some who will wish to combine this block with anterior splanchnic anesthesia in preference to gas for intra-abdominal operations. We have had no experience with splanchnic anesthesia.

## SUMMARY

Bilateral block of the seventh through the eleventh intercostal nerves in the midaxillary line combined with light gas inhalation constitutes an extremely safe and satisfactory anesthesia for upper abdominal operations on certain seriously ill patients presenting contra-indications both to ether and spinal anesthesia.

It possesses all of the virtues of spinal anesthesia, such as complete relaxation and absence of pushing of intestines without any of the dangers sometimes associated with its use. Because of the relaxation, closure is rapid and the operation accordingly shorter. By the same token, approximation of the posterior rectus sheath and peritoneum is accurate and thus an important factor in the development of postoperative hernia is eliminated.

For plastic procedures on the upper two-thirds of the abdominal wall such as repair of umbilical and incisional hernias, secondary closure subsequent to eventration, and closure of colostomy in the transverse colon it has proved most useful.

The technique of injection is so simple that failure to obtain anesthesia should be rare. The time required for administration of the anesthesia is no longer than that involved in giving a spinal anesthesia and the duration obtained is sufficient for the completion of any operation one is apt to be required to perform in the upper abdomen or upon its wall.

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# SLIPPING OF THE UPPER FEMORAL EPIPHYSIS

Dr HENNING WALDENSTRÖM Stockholm, Sweden

**S**LIPPING of the upper femoral epiphysis is no longer regarded as a fracture. It does not depend for its origin upon trauma. Instead the prerequisite is deficient bone formation between the epiphyseal cartilage and the metaphysis (collum). Due to this defect the newly formed cells do not hold firmly enough together to be able to resist the pressure normally exerted on the head of the femur. The result is a displacement in the actual zone of ossification that is, between the metaphysis and the epiphyseal cartilage, so that the epiphysis is displaced downward and backward in relation to the metaphysis. This softening process is transitory and, when it is at an end, the epiphysis ceases to slip and becomes firmly fixed in its new place. The deformity following displacement of the epiphysis is known as *coxa vara* and, in order to distinguish it from *coxa vara* of other origins, as epiphyseolytic *coxa vara*.

Before its real origin was known, the theory was that the deformity was the result of the femoral neck becoming curved; then it was called essential, static, or adolescent *coxa vara*. Distinction was made between this type of *coxa vara*, then considered to be the most common, and the type seen after epiphyseal slipping. This distinction was made probably because epiphyseal slipping was regarded more or less as a fracture, the direct result of trauma. We now know that epiphyseal slipping may be quite free of symptoms or at least cause so little trouble that medical care is not sought. In such cases the stages in the displacement are so closely spaced that one is tempted to speak of the condition as a continuous displacement of the epiphysis. Thus the only difference, either pathological or roentgenographic, between what used to be called essential *coxa vara* and the final stage of an epiphyseal separation is the manner of the slipping. In the former it proceeds slowly and almost imperceptibly and in the latter rapidly and is accompanied by more or less pronounced discomfort. The fundamental cause of the primary weakening of the metaphysis is not known, but there is strong evidence that it is to be sought in the disturbance of internal secretion during puberty.

From the Karolinska Institute's Orthopedic Clinic.  
On the invitation of the University of Liverpool the author delivered this lecture as the Lady Jones Memorial Lecturer on March 9, 1939.

For a better understanding of these cases it is important to know the rate of the epiphyseolysis in relation to other conditions. Hence I shall give a comparison based on material obtained in Sweden.

The number of patients treated at our hospitals between 1932 and 1937 was 184 cases of *coxa plana* (Lasek) an incidence of 1.15 per cent. In epiphyseolysis, an incidence of 0.70 per cent. Epiphyseolysis is, therefore, less common than *coxa plana*. However it is of greater importance to recognize it early since excellent results can be obtained if it is treated correctly while the epiphysis is still soft. The type of treatment generally used up to now for separation of the epiphysis has led to much greater results than has treatment for *coxa plana*.

The cause of epiphyseolysis seems to be of constitutional character. In about one fifth of the cases it is bilateral and in about one half the cases signs are found of endocrine disturbance: obesity, undeveloped external genitalia, stunted growth—a picture resembling dysadipogenitalia. However this term applies to those serious disturbances which are caused by tumors near the hypophysis and in hypofunction of the gland from birth. Therefore the mild and often transient disturbances here in question should be called adipoogenital type of dystrophy. The latter mentioned make it probable that epiphyseolysis—apparently a local condition—is the result of disturbances in the internal secretions of the endocrine glands is mainly involved, not known, but we do know that the anterior pituitary gland controls endochondral ossification and that it and the sexual glands are interrelated. In order that the body may function normally co-operation between the various endocrine glands must be well balanced. The type of the adipoogenital type of dystrophy is evidence that certain difficulties must come before the functions of the various endocrine glands become adjusted to each other. In the adipoogenital type of dystrophy is disturbance of temporary character, so is epiphyseolysis also transitory. As already stated it occurs at a certain age, that is, during the period of puberty. The length of time during which

can appear may be determined by examining all the bilateral cases in which displacement occurred more than once and calculating the time elapsed from the first roentgenological symptom of the first displacement to the first symptom of the last displacement. One and a half years was the longest time in any of my cases. Usually the time was 1 year, and this period corresponds to that in the cases reported in the literature. But why should an endocrine disturbance be suspected when two-thirds of the patients appear to be normal with no signs of obesity or defective development of the genitals? It must be said in this connection that disturbances in internal secretion may exist without causing any external changes. Furthermore, some young people with epiphyseal slipping are very tall and thin for their age. In young people hypertrophy of the anterior lobe of the hypophysis causes gigantism and atrophy of the anterior lobe causes dwarfism and in both instances the anterior pituitary hormone influences the endochondral ossification. It is possible, therefore, that, in addition to stimulating or inhibiting growth, a hyperfunctioning or hypofunctioning gland may also cause weakening of the newly formed layer of bone next to the epiphyseal cartilage. No other disturbance which points directly to the hypophysis has been demonstrable. There might be some change in size which would be revealed on a roentgenogram of the sella turcica, but innumerable investigations have yielded no result in this respect. No disturbance in calcium or phosphorus metabolism is observed in diseases of the hypophysis or in epiphyseal slipping.

It is clear from the foregoing that a disturbance in internal secretions must be considered as a possible primary cause of epiphyseal slipping. Therefore, as the background of every such case we must assume that there is a stage during which the new bone is not normal, a certain period during which the newly formed layer is not sufficiently resistant. Theoretically this condition must exist, but has anyone ever seen it, or can it conceivably ever be seen by any of the methods now at our disposal? Of course, it is possible that this stage may be accompanied by special pathological changes, but this is not certain. The adiposogenital type shows no changes in the ossification of the epiphyseal line before the slipping, and only exceedingly few cases of this disease are complicated by epiphyseal slipping. Furthermore, it is impossible to know in advance which of them will be so complicated.

Examination of specimens from cases in which slipping is already in progress shows nothing which might be of assistance in explaining the nature of the complaint. All that is revealed is

the typical picture of absorption and new bone and cartilage formation.

Some investigators state that roentgenograms taken early in the disease show what they call the "preslipping stage." Characteristic of this stage is said to be the finding of an epiphyseal line broader and less dense than normal. Close examination of such pictures reveals a condition resembling the very beginning of an epiphyseal displacement. That which has been interpreted as the preslipping stage constitutes the first signs of epiphyseal displacement. This question is discussed farther on.

Even if a hypothetical pituitary disturbance is the primary cause of epiphyseal slipping, it is conceivable that some other general organic disturbance might produce a change in enchondral ossification. Common rickets reduces the power of resistance of the newly formed bone but only bending of the softer tissue. In the hip this results in a softened metaphysis becoming curved, a coxa vara deformity. Rickets is no longer present when epiphyseal slipping appears. Hence ordinary rickets cannot cause typical epiphyseal displacement.

Brailsford, of Birmingham, however, has shown that an extremely rare disease called "renal rickets" may give rise to typical epiphyseal slipping. In such cases the defective calcification in the newly formed bone tissue resembles that in common rickets. The word "renal" is used because in most of the cases hitherto described the patients have all suffered from chronic disease of the kidneys, characterized mainly by increased residual nitrogen. Acidosis with consequent release of calcium salts in the newly formed bone tissue has been considered to be the cause of the condition. In his handbook *The Radiology of Bones and Joints*, London, 1935, Brailsford reports a case of typical slipping of the upper femoral epiphysis first on one side and then on the other in a patient affected with renal rickets. He has been kind enough to send me his original pictures and a detailed description of the case.

I have been able to follow 1 case of renal rickets which was described by Gordh in *Proceedings of the Northern Orthopedic Association at Its XIX Meeting in Stockholm 1938* in *Acta orthop*. In this case important changes were noted in both hip joints. On one side there was a broad zone of decalcified bone. Despite this, the epiphysis did not become loosened during the year I observed the patient, although she continued to walk. The defective ossification in the other hip was localized in the epiphysis, which had become softened and squeezed together in a manner closely resembling that in coxa plana.

On the basis of Bradford's hypothesis, that slipping of the epiphysis is due to renal rickets I determined the residual nitrogen and the calcium and phosphorus content of the blood of 7 cases of recent epiphyseolysis which have come to my attention. All were normal in these respects, and none showed albumin in the urine or the usual signs of nephritis. Even though Bradford's case is of great interest in so far as it demonstrates that the cause of slipping of the epiphysis must be in more than one direction nevertheless renal rickets is so unusual that it must be regarded only as an exceptional cause of this condition.

As has been stated, the cause of slipping of the upper femoral epiphysis is insufficient strength in the newly formed layer of bone in the metaphysis next to the epiphyseal cartilage. This weakness naturally varies in degree. It may be so insignificant that great violence is required to cause displacement, or it may be so pronounced that the mere walking of the patient causes epiphyseal loosening. In one instance considerable displacement occurred while patient was lying in bed.

Up to the present I have spoken of the epiphysis becoming displaced. Actually it remains in the acetabulum where it rotates backward and downward, while the femoral neck twists in the opposite direction, forward and backward. However it is easier to describe and understand the movements of the epiphysis.

#### ANATOMY OF SLIPPING OF THE UPPER FEMORAL EPIPHYSIS

The head comprises that part of the upper end of the femur which is covered with a layer of articular cartilage about 3 millimeters thick. It is round and constitutes approximately three-quarters of a sphere. The neck extends from the outer edge of the head to the trochanteric area. In early childhood its entire surface is covered with cartilage but after the age of 10 only its upper anterior portion (Fig. 1) is thus covered. The cartilage on the upper part continues directly into the cartilage in the greater trochanter.

The metaphysis (the zone of growth) is the part of the neck nearest to the epiphyseal cartilage and is comprised of three parts during the period now in question (1) the zone of calcified cartilaginous cells adjacent to the epiphyseal cartilage which are ready to become transformed into bony tissue, (2) newly formed bony tissue and (3) a band of joint cartilage surrounding the metaphysis and comprising the lateral part of the joint surface of the head (Fig. 1 between a-c).

The head, i. e. the principal part of the upper end of the femur thus includes the epiphysis and

metaphysis. It is in the newly formed layer of bone of the metaphysis that displacement of the epiphysis takes place and not in the epiphyseal cartilage (Fig. 2). The surface of the epiphyseal cartilage facing the metaphysis is not smooth but unevenly furrowed and pitted, particularly near the periphery where it also curves down and covers the metaphysis. The articular cartilage totally follows the epiphysis when the latter displaces, taking with it the edges of the metaphysis (Fig. 3). These edges fill up the pocket formed between the distal free part of the joint cartilage and the periphery of the epiphyseal cartilage. The part of the epiphysis facing the metaphysis (the slipping surface) thereby becomes more rounded than if the slipping had taken place along the epiphyseal cartilage. The slipping epiphysis forms a rounded excavation against the metaphysis and the metaphysis a corresponding spherical surface. More easily to understand the slipping it may be said that it occurs in a spherical articulation between the epiphysis and the metaphysis.

In pronounced displacement, as soon as the joint is opened the upper anterior surface of the neck is found to be rounded at the point where previously it was concealed by the epiphysis. The epiphyseal cartilage is of course not a plain surface but is unevenly furrowed (Fig. 3). However anteroposteriorly it is horizontal, although lateromedially there is an inclination of about 10 to 20 degrees. If epiphyseolysis appears, the epiphysis rotates backward and downward. In all probability it is the incessant movements taking place in the hip joint with the perpetually varying load on the head that break the already weakened connections between the epiphysis and metaphysis.

No special exertion is required to loosen the weak bond. As a rule therefore the first displacement or perhaps, displacements are insignificant. It does not appear improbable that, at first the slipping is continuous, or rather takes place by degrees. The more the epiphysis is shifted backward in this manner the less support it receives posteriorly. The weight of the body which previously appeared to be unevenly distributed with the pressure shifted somewhat backward, has an even greater action now that the epiphysis is beyond the metaphysis, and causes the epiphysis to rotate backward and downward toward the edge of the metaphysis. The farther back the epiphysis comes, the more it is exposed to body weight.

The foregoing may explain the fact that nearly all, or perhaps all cases of epiphyseal slipping, go through stages of minor displacements before a major one occurs, and that the later displacements are never as slight as the first ones.

# WALDENSTRÖM SLIPPING OF UPPER FEMORAL EPIPHYSIS

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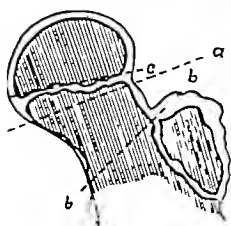


Fig 1

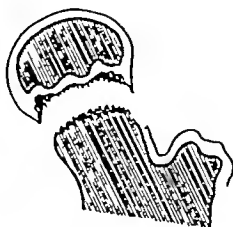


Fig 2

## THE ROENTGENOGRAPHIC APPEARANCE OF EPIPHYSEAL SLIPPING

First let me say a few words about the x-ray examination. To be able to follow the development of epiphyseal slipping and, of even greater importance, in order to establish a diagnosis at the very beginning of the process, first class x-ray equipment is required and an operator who is not only a good technician but who is also specially trained to interpret what he sees.

As to the technique, the roentgenograms should always be taken at the same distance. The custom at the orthopedic clinic in Stockholm is to have 1 meter between the focus and the film. Similar exposures must be made of both hip joints on one and the same film. For example, if inward rotation is impossible in one hip, the other one must also be pictured in outward rotation, etc.

In epiphyseal slipping as in many other hip diseases, for example coxa plana, lateral views are the most informative. It must be considered a serious error, therefore, not to take a view in lateral position, Lauenstein's position, as a matter of routine in all hip diseases. The epiphysis displaces backward and downward, and obviously advantage the extent of the displacement, but are the first upon which it will appear. When taking these views, the patient's knee is supported with a hard, round, large cushion. The hips are abducted to 70 degrees and flexed to about 80 degrees with the same rotation on both sides, in the picture the greater trochanter should be seen projected onto the neck, the contours of the two bones coinciding as far as possible. In this way it is easy to check to see that both hips are in the same position. The picture is taken from the front with the legs parallel if possible and rotated, preferably to midposition. In the earlier stages the best way to discover the extent of the displacement is to cut the film in two and superimpose one picture on the other. Care should be taken to apply the outlines of the neck to each other, after which comparison of the peripheries of the two epiphyses reveals whether any slipping has taken place. Displacement in the

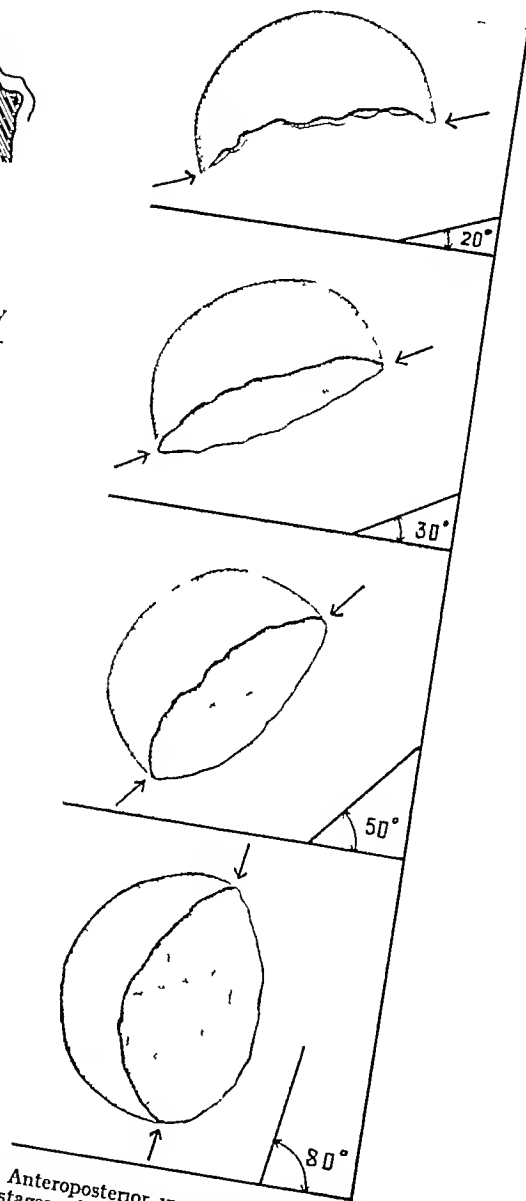


Fig 3 Anteroposterior view of the epiphysis in three different stages of displacement. a, Normal position—20 degrees of inclination, b, early slipping—30 degrees of inclination and rotation backward on an axis indicated by the two arrows, c, more advanced slipping—50 degrees of inclination and rotation increased so that more is to be seen of the epiphyseal cartilage, d, maximal slipping—80 degrees of inclination and still more rotation.

postero-inferior part is shown best in the lateral view and displacement in the supero-external part in the anterior view. Good exposures in a suitable



Fig. 4. Case . a, July 2, 1935 b, October 24, 1935 c, November 27, 1937

position will show slipping of the epiphysis in a very early stage when it is displaced less than 1 millimeter.

Epiphysal slipping is always best diagnosed on the basis of a lateral view i. e. in flexion abduction position Lauenstein's position. A good example of this is the following case:

**CASE 1.** A boy of normal type, born 1920, during the spring of 1935 suffered periodically from pain in his left knee when walking. An x-ray examination of his hip as made at another hospital on July 1, 1935 (Fig. 4, a) from which I borrowed the film. I have included only the view in the lateral position. The epiphysis projects beyond the metaphysal line a small hook. Furthermore the epiphysal line is seen to be broader and more translucent than normal. The patient was treated, but for too short a time, and was readmitted to the hospital 3 months later with more extensive displacement than on the first occasion (Fig. 4, b, October 4, 1935). He was then sent to my hospital, but during the trip his hip became more painful and the next picture taken at my hospital, shows marked displacement. He was then put in skeletal traction with weight of 8 kilograms for 3 days. Some improvement of the position of the epiphysis could be noted. He was then treated with continuous adhesive extension with weight of 4 kilograms for 3 months, after which he stayed in bed with massage and gentle exercises for another month. He began to walk with crutches for 6 months. In the roentgenograms the position of the epiphysis is seen to have improved but this is not entirely true, since during the year of treatment the body's reparative elements have been in action and the neck has been absorbed superiorly and built out inferiorly of the epiphysis. The position of the epiphysis is a little better 12 months after it has freed itself from the metaphysal

enveloped clearly the low medially displaced epiphysis. Nothing was then done with Smith-Petersen nail.

I have since been able to borrow the roentgenograms taken at the first hospital. A comparison of the pictures of the two hips in lateral view reveals the displacement. The epiphysal hook, downward and medial displacement of the epiphysis can be seen. The anterior view, on the other hand, appears normal, except that the epiphysal line is somewhat broader than in the sound side (Fig. 5, a and b).

Thus, in early cases, it is sometimes impossible to see the displacement of the epiphysis in an anterior view. However, on this picture a condition is seen which is occasionally inaccurately described as the pre-slipping stage. If the slipping is a little more pronounced than in this case it will be seen from the next case that early stages of epiphysal slipping can be diagnosed from an anterior view, but this does not alter the fact that a lateral view must also always be taken.

**CASE 2.** A boy born in 1913 had been limping slightly for 3 months. He was subjected to x-ray examination at another hospital where the defect was normal hips and no treatment. He gradually became worse until, hardly one day after gymnastics 4 months later he could not walk. The following day he was roentgenographed and on this occasion the anterior view revealed distinct slipping (Fig. 6, September 6, 1937). Films from the first examination were borrowed and showed the epiphysis to be lowered 1 millimeter and medially displaced 1 millimeters (Fig. 6, May 3, 1937). The comparison is best made by placing the pictures of the two hips on each other (see the comparison of both epiphyses superimposed). The epiphysal line is broader and more uneven than normal. The neck of the femur has been called the non-broader, here but

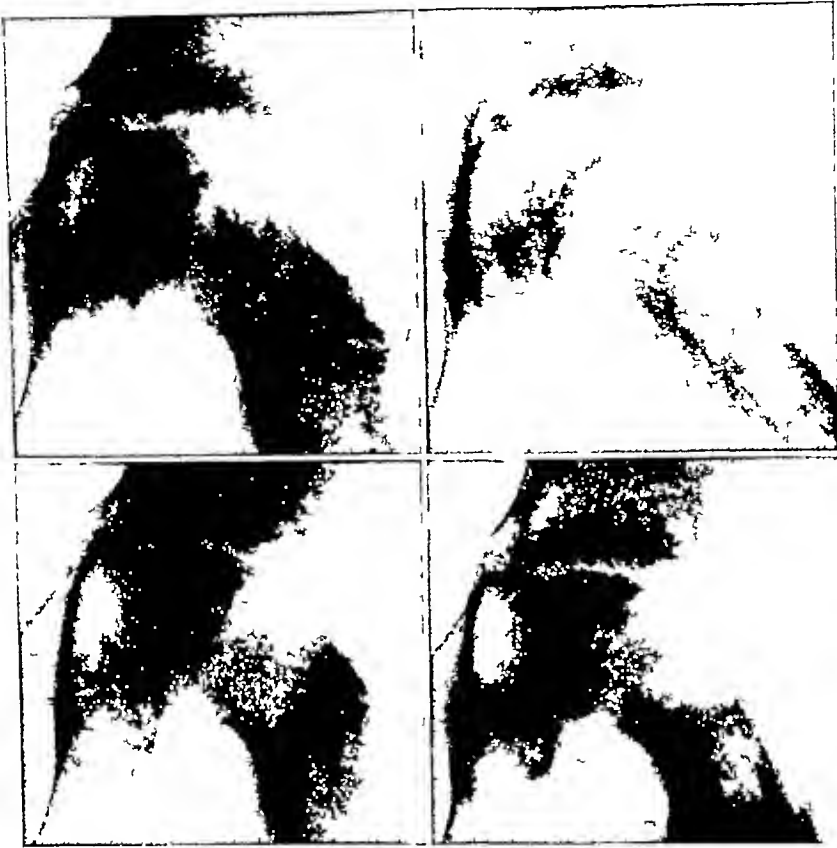


Fig 5 Case 2 a, Above, July 12, 1938, b, below, November 8, 1938

chipped. Small splinters naturally get out of place and thus cause the uneven appearance of the surfaces facing one another. The anterior view also reveals the widened epiphyseal line and a medial displacement of the epiphysis. Roentgenograms (Fig 7, b) taken May 28, 1938, 7 months after the first ones, show that a bracket has been built out after an earlier displacement, but that the epiphysis lacks support to some extent, indicating a rather recent displacement.

#### CHOICE OF TECHNIQUE

As to the choice of method I shall repeat what I have said before. Reduction under anesthesia should never be done, and this for two reasons. It generally does not result in reposition and, what is more important, the function of the joint is completely destroyed in one-fifth of the joints treated in this manner. After the so called reduction, which takes place with the hip greatly rotated inward, and after the plaster is applied in the same position, both hips are roentgenographed. In order to demonstrate the difficulty of judging the relationship of the epiphysis to the metaphysis in

the different stages of rotation, I have produced an epiphyseal slipping in a preparation from an 11 year old child (Fig 8). The upper pictures show the epiphysis fixed and roentgenographed as usual in the anteroposterior and lateral views (Fig 8, a and b). Movements were then made with continued fixation in the same position between the epiphysis and metaphysis. The hip was then roentgenographed in internal rotation of 40 degrees, i e, as much as could be done normally. The roentgenogram shows the lower outline of the epiphysis to coincide with that of the metaphysis (Fig 8, c). It resembles very closely an x-ray picture showing a successful reduction. The next picture shows internal rotation of 50 degrees and abduction of 40 degrees (Fig 8, d). Here it appears as if the displacement had been overcorrected. Compare with the pictures of a case of reduction which I recently borrowed from another hospital. Figure 9, a, shows fresh slipping, b, after 10 days of skeletal traction, c, the same position between





Fig 6. Case 3 a, above, May 2, 1937 b, below September 6, 1937

epiphysis and metaphysis as in b but there is inward rotation 40 degrees.

It is impossible to determine the position of the epiphysis unless symmetrical pictures of both hips are available for comparison. A careful examination of the so called successful reductions will reveal that very few of them show any improvement whatever in other words the results are extremely poor.

A review of my cases previous to 1924 when I stopped performing reduction under anesthesia shows that, in 4 of 5 cases, the head of the femur became partially necrotic. In short, the treatment caused actual damage in one-fifth of the cases in my series (Fig 10)

McMurray said in 1938 "In 25 per cent of cases treated in this manner rigidity of the joint appears at a later date after an apparently satisfactory increase of movements. Such rigidity is caused by the development of arthritic changes which are the result of injury and interfere with hip motion."

Phillip Wilson has followed with closed reduction and of stiffness and restricted these curved the u  
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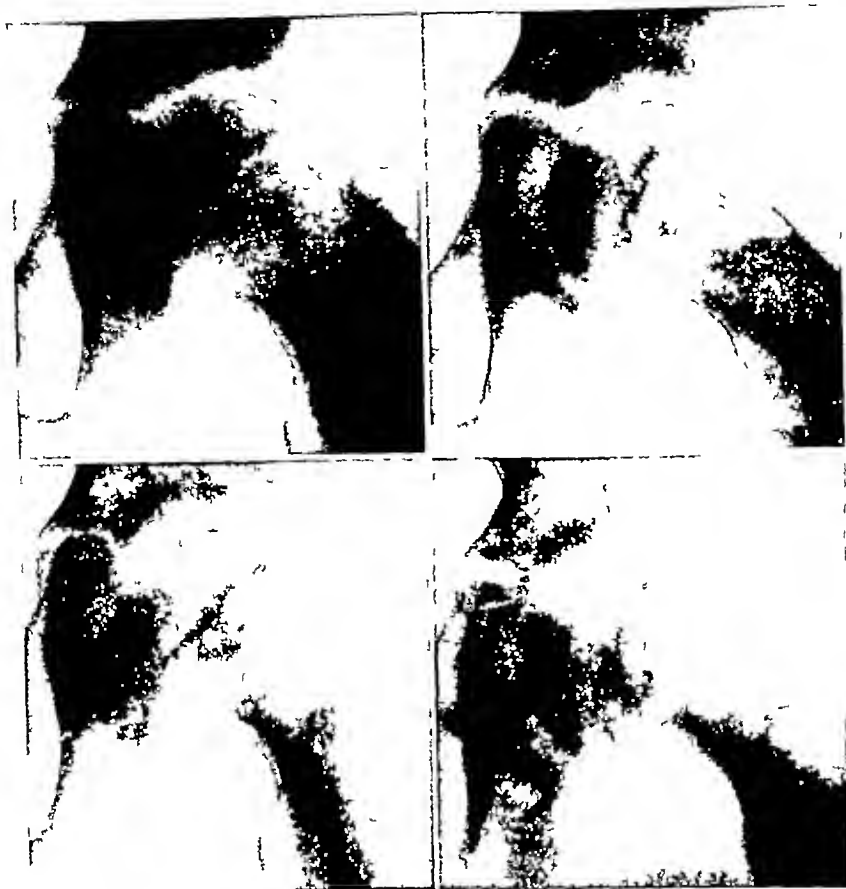


Fig 7 Case 4. a, Above, November 5, 1937, b, below, May 28, 1938

tive reduction without any damage to the ligamentum teres has given excellent results as far as the position of the epiphysis is concerned but, like the "closed reduction," entailed the risk of the head necrosis. Therefore, this method also cannot be recommended. The foregoing should emphasize my idea of how epiphyseal slipping should not be treated.

As to how recent epiphyseal slipping should be treated, I have found the following to be satisfactory.

Until last summer, all my cases were treated with adhesive extension, with the hip first in mid-position and then in gradually increased abduction and internal rotation. A weight of 4 to 5 kilograms was used for the purpose. After 2 months the bandages were removed, but the patient remained in bed for another month and was given massage and gentle exercise. Crutches were then

used for 6 months and afterward two sticks until the x-ray revealed that the epiphyseal line had closed, which took about 1 year. I have used this method more than any other, and consider it to be the most conservative and to give as good results as reduction under anesthesia but without any risk for necrosis. However, it involves some risk of recurrence with consequent poor results.

While in America in the winter of 1938, I learned a new method which obviates this risk and is perhaps better in other respects. I was fortunate in being able to see Philip Wilson at work in New York. Like many other surgeons, he used to attempt to perform reduction under narcosis, but he abandoned this method as long ago as 1922, since he found that it seldom if ever was successful and, in several instances, was followed by necrosis of the femoral head. Since 1934 he has used nail fixation in the treatment of slight displacement,



Fig. 8. a, b, Epiphysis fixed and roentgenographed in anteroposterior and lateral views; c, epiphysis coxae with acetabular; d, internal rotation of 30 degrees and reduction of 40 degrees.

i. e. in cases in which the lateral roentgenogram shows that the epiphysis has not displaced posteriorly more than one-third of the diameter of the neck. He uses the Smith-Petersen nail for the purpose. I had an opportunity to see several of Wilson's cases, of which there are 9: the first one having been operated upon in 1934. I found the results to be good. A few months after my return to Sweden, one of my patients who had a minimal slipping on one side which had been stationary for 1½ years and therefore was considered healed had a new displacement. Displacement was so great that it was impossible to treat it either with adhesive or nail extension. If nailing had been done in time in this case the patient would in all probability now have a normal hip. In order to avoid such disasters, I decided to nail all cases of epiphyseolysis, according to the method of Wilson. Since then 5 patients have received this treatment. As prescribed by Wilson they have been kept in bed for 1 month and then have used

crutches for another month after which they have gone back to school, but have taken no part in any sport until the epiphyseal line has closed, which Wilson states usually takes place within a year at which time he removes the nail.

The follow up period has been too short to provide any conclusive evidence in the 5 patients treated by nailing at my hospital since the summer of 1938 but I intend to continue using Wilson's method for the present. With regard to the technique the direction of the nail must be adjusted to correspond with the position of the head, i. e., more backward and less upward than in reduction of a fracture of the neck. The position of the head is about the same as that found in an unreduced fracture of the neck. The drill is inserted by hand and directed against scale in the groin. In my opinion it is not so important to go so deep into the head as in fractures of the neck, and probably

re-accumulation of any melted cases was made as seen, however, and all of them had gone back to school walking without limping and showing nearly normal mobility of their hips.

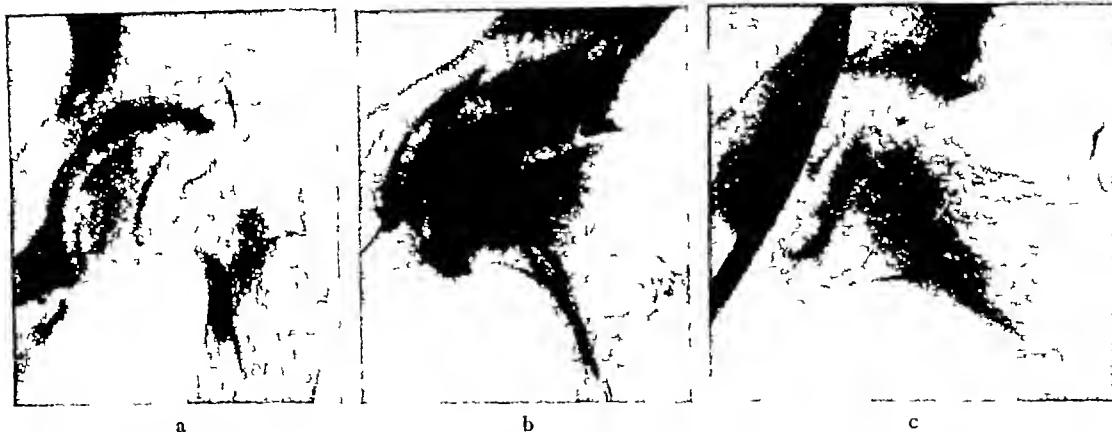


Fig 9 Roentgenograms from case in another hospital a, Fresh slipping, b, after 10 days, c, same as in b but inward rotation of 40 degrees

all that is required is to nail right through the epiphyseal cartilage. The healing conditions also are much more favorable than in a medial fracture of the neck.

Therefore, it is possible that this treatment is definitely indicated for minor epiphyseal slipping. However, for more advanced slipping it is not so simple to decide what is best, except when it is a question of severe displacement or cases in which the epiphysis has fused. Then cuneiform torsion osteotomy should be performed.

There comes a day for all these cases of epiphyseolysis when the internal secretions are balanced and no further displacement can occur. The femoral head then fuses wherever it happens to be. Reparatory processes are initiated. Superfluous bony parts are absorbed and gaps are filled in accordance with the usual laws of regeneration in

the skeletal system. The part of the neck projecting upward and forward, where the head was once attached, is absorbed. This remodeling process is illustrated in 3 pictures (Fig 11), which show the rapid development of this remodeling process during 1 year. The mobility of the hip increases as the absorption proceeds.

The development of an epiphyseal displacement into coxa vara may be followed in some pictures. Lateral views of these early cases show bony tissue growing out inferoposteriorly from the neck to meet the slipped epiphysis. They also reveal that the projecting part of the neck, where the epiphysis previously had its place, is beginning to be absorbed. The later development can be studied in Figure 12, which shows how the inferoposterior part of the neck grows out and entirely fills up the space between the epiphysis



Fig 10 Right hip ankylosed mobility of left greatly limited

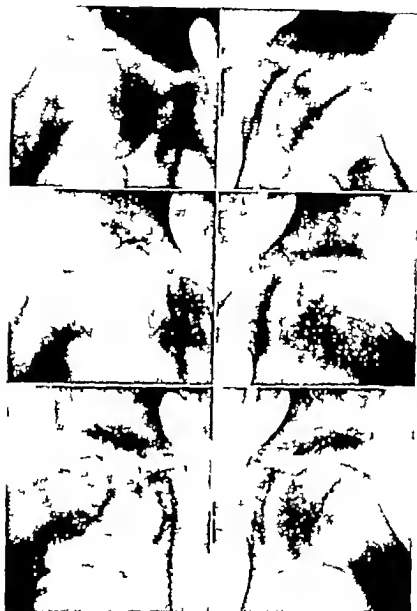


Fig. 1. Remodeling process: top, August 8, 1937; middle, November 3, 1937; and, below May 3, 1938.

and neck while, at the same time the upper projecting part of the neck, where the epiphysis used to be attached, is absorbed. The upper outline of the neck thereby becomes convex and the lower outline concave giving the impression that the entire neck is curved. The spongy framework in

the neck also begins to adapt itself to the new static conditions. Figure 3 illustrates later stage in the evolution into coxa vara. form of the neck and its more distinct as well as density of the compact

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Fig 12 Inferoposterior part of neck is grown out and fills space between epiphysis and neck

the neck, where the weight of the body is concentrated and the need for strength most pronounced

The slipping may stop at any point. Therefore the epiphysis may become fused after such an insignificant displacement so that it can scarcely be detected that it ever had slipped. I believe that it is of great importance not only to discover epiphyseolysis as early as possible, but also to have the epiphysis fused in its new position as rapidly and with as little traumatism as possible. We know that in cases of solution of continuity of any part of the skeleton, the more completely immobilization is carried out the less callus is formed during the healing process. I think we are dealing with the same problems which led Hugh Owen Thomas to lay special stress on the importance of rest. The same is true with regard to fusion of the epiphysis after slipping. If the patient is allowed up too soon, there is a risk not only of further displacement, but also of more callus being formed around the border of the slipped epiphysis, marginal osteophytes arise with the consequent danger of an early appearance of arthritis deformans.

A number of early cases of arthritis deformans in the hip joint are undoubtedly caused by incompletely healed epiphyseolysis during childhood in which the patient never stayed in bed, so that the healing was constantly disturbed but only very slight slipping was caused. An insignificant displacement may present so few symptoms during childhood that it is forgotten by the time the patient is grown up. Many cases of arthritis deformans in adults have their origin in a congenital deformity or in a deformity which had been ac-

quired during childhood. It is very often difficult to determine to what morbid process during childhood or adolescence secondary arthritic changes are due, unless the cases have been followed from the beginning.

As we know, the articular cartilage is nourished by the synovia. Normal mobility is, therefore, of great importance in the transportation of the nutritive fluid, and a normal capsule is essential for the production of the necessary amount of joint fluid and for its proper composition. If the nutrition of the head is disturbed due to more or less extensive tears and if the epiphysis heals with edges, the capsule also suffers injury and its capacity to nourish the cartilage is thereby reduced. The nutrition of the articular cartilage is then not the same as in a normal joint, and such a condition favors the early appearance of arthritis deformans. The most severe cases of early arthritis deformans which I have seen are those which have undergone so called reduction under narcosis and developed more or less extensive partial necrosis of the head. I myself performed reposition in a case of epiphyseolysis—in one hip in 1913 and in the other in 1914. Roentgenograms taken immediately after the operation show what is popularly supposed to be successful reduction on both sides, that this was not the case is now obvious, and that the patient suffers great discomfort from the ensuing arthritis deformans is clear from the picture.

The series of roentgenograms presented were selected from my material to illustrate certain important points.



Fig. 3. Later stage in evolution of coxa vara.

Some improvement in position may be obtained by means of adhesive extension or a short period of wire extension (10 days at the most) with the hip in outward rotation.

The so called reposition under narcosis is, as a rule, no reposition at all. It is *misinterpretation* of the roentgenograms.

Reposition under narcosis should never be performed, since in about every fifth case, it entails destruction of the joint (necrosis of the head).

Reposition by means of arthrotomy may give excellent results, but this method also is inadvisable, since it is attended with the same risk (necrosis of the head) even if the ligamentum teres has been spared.

Reconstructive processes following epiphyseal displacement often proceed rapidly and thus cause an apparent reposition.

Epiphyseolysis may develop into coxa vara.

Premature arthritis deformans may appear in patients who have had epiphyseolysis in their youth particularly if they have undergone reposition under narcosis.

It is my belief that premature arthritis deformans can be prevented if diagnosis is made early and conservative treatment carried out efficiently and for a long period, in order to allow the even contours of the head to return.

#### CONCLUSIONS

The diagnosis of slipping of the femoral head while the slipping is still minimal is of extreme

importance in the prognosis. The symptoms must never be made light of. A youngster who limps, or whose parents state that he occasionally limps, should be subjected to a thorough examination. Even if examination reveals that there is present only the slightest limitation of mobility a roentgen-ray examination should immediately be performed and the roentgenograms should be carefully studied.

In the early stages the diagnosis should not be made from an anteroposterior view; the only significant signs are revealed in the lateral view. The significant signs are three, namely: the epiphyseal hook, down the metaphyseal edge up and the broader epiphyseal line.

Entirely satisfactory therapeutic results can be obtained only if the diagnosis is made at an early stage. As soon as the condition is diagnosed the patient should be hospitalized, since another and perhaps more serious displacement may occur at any time. The treatment should be continued until the epiphysis has become so well fused that further slipping is impossible. The best method when conditions are not too severe is the one in which Smith-Petersen nail is applied after the method of Wilson and this method can be used as long as two-thirds of the epiphysis is in contact with the metaphysis.

The sound hip should be carefully supervised during the whole course of the treatment, since in 25 per cent of the cases the condition becomes bilateral.

# THE TREATMENT OF ADYNAMIC ILEUS BY GASTRO-INTESTINAL INTUBATION IN CHILDREN

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**A**DYNAMIC ileus, always a dreaded surgical complication, is apt to be particularly dangerous in children. The lability of children in illness is familiar to all, their reaction to distention is particularly marked. They show the effects of starvation very early in a tendency toward acidosis, with more rapid wasting, dehydration, and mineral loss. These factors coupled with the added difficulties in treatment justify a special consideration of the problem of distention in children. The causes of ileus are much the same as in adults and may be classified as follows: (1) Postoperative, presumably on basis of trauma, (2) intraperitoneal inflammation—peritonitis, abscess, etc., (3) extraperitoneal inflammation, trauma, toxemia—retroperitoneal, hematoma, fractures of spine and pelvis, renal lesions, pneumonia, etc.

Experimental evidence indicates that adynamic ileus is produced by the agents named through a reflex inhibition of the normal intestinal motility (2, 12, 15). A physiological ileus follows laparotomy (12, 18) and it is only when it fails to subside that it can properly be termed paralytic, or adynamic ileus. The sequence of events is no different in children, while mild degrees are less common than in adults, severe adynamic ileus is less well tolerated due to the factors mentioned.

Various forms of treatment have been proposed and their very multiplicity is eloquent testimony to the fact that no one of them has proved uniformly satisfactory. Most important is undoubtedly prophylaxis, adequate pre operative preparation both physical and psychic, with adequate fluid intake and avoidance of catharsis will do much to minimize postoperative distention. Likewise gentleness of all operative procedures, attention to the problem of water balance (3), and avoidance of excessive stimulation of gastrointestinal tract by catharsis and enemas during the postoperative period will further aid in keeping down the incidence of ileus.

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Once adynamic ileus has appeared we are faced with the need (particularly urgent in children) for some means of reducing the distention with a minimum of disturbance to the patient. Methods which have been proposed for the treatment of ileus may be listed as follows: (1) enemas and local applications, (2) drugs, (3) oxygen therapy, (4) spinal anesthesia, (5) enterostomy, (6) suction drainage—(a) gastric, (b) duodenal, (c) intestinal.

Enemas, stipes, and other local applications have been used for many years in the treatment of all forms of distention. Enemas at best empty only the colon with little or no effect upon the distention of the small intestine, they are somewhat irritating to the colon and upsetting to the patient. It has been pointed out by Ochsner (19) that they frequently actually aggravate the condition they are meant to relieve. Stipes and other local applications probably have no effect upon the distention and their repeated application adds another factor to disturb the patient's rest. There is some evidence that external dry heat to the abdomen in the form of a light cradle may be both soothing to the patient and helpful in reducing the effects of distention (16).

Drugs, among them pituitrin, eserine, pitressin, prostigmine and intravenous salt solutions, have seen considerable use. Many of them are ineffective even when tested experimentally, all have the disadvantage that their effectiveness is dependent upon stimulation of musculature which is already overloaded by distention. The activity of these various drugs has been well summarized by

TABLE I —ADYNAMIC ILEUS IN CHILDREN

Initiating lesion	Cases	Lived	Died
Appendicitis—			
Acute	4	4	
Abscess	8	8	
Local peritonitis	6	6	
Diffuse peritonitis	10	8	2
Gunshot—abdomen	2	2	
Tuberculous peritonitis	2	1	1
Atony with partial obstruction	1	1	
	<hr/> 35	<hr/> 30	<hr/> 3
Per cent		90 9	9 1





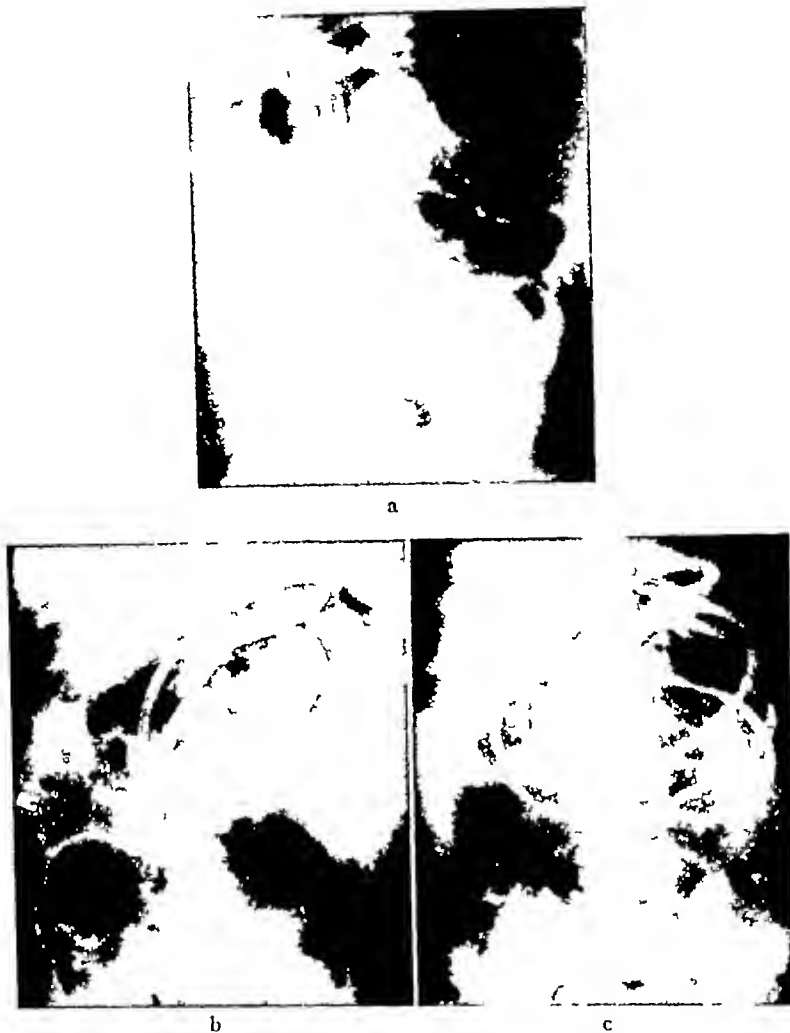


Fig 4 a, July 3, 1939, b, July 8, 1939, c, July 10, 1939

While this is not intended as a presentation of cases of appendicitis, it is worth while to point out several important facts emphasized by the data. That the mortality from appendicitis in children need not be excessive is apparent from a study of the 172 such cases here presented (Table II). While the mortality in this group was quite low (11 per cent) we do not feel that the series is large enough to indicate a mortality figure which might routinely be expected in the handling of all types of appendicitis. Nevertheless it does indicate that in early appendicitis with proper handling the mortality can be kept at a minimum. An additional point which might be emphasized is that in this group the incidence of ileus was low.

None of these patients were operated upon through a right rectus muscle splitting type of incision, the adoption of an incision which approaches the appendix from directly over the cecum has undoubtedly contributed to the low incidence of postoperative distention. In those cases in which ileus did occur early use of the tube tended to reduce its severity and duration. In this regard it is likewise interesting to note the direct relationship between the severity of the disease and the incidence of ileus, (Fig 1 and Table III) none of the recurrent cases and only an occasional case of simple acute appendicitis showed postoperative distention, while this complication was almost the rule in the various forms of appendiceal

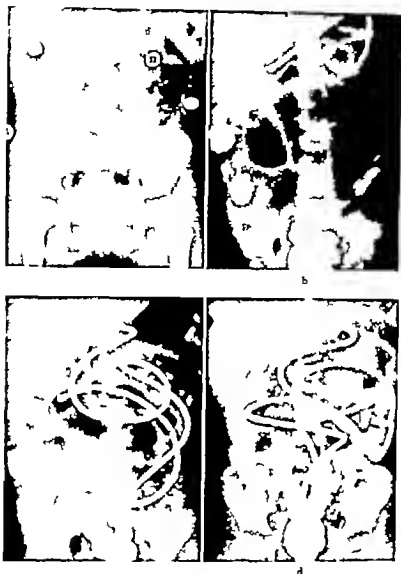


Fig 3. a, October 1938. Barium enema as given before consultation on October 1938 because of suspected lesion of the large bowel. b, October 24, 1938. c, October 26, 1938. d, October 7, 1938.

near the point of obstruction (17). This fact is particularly important in children who quickly show the ill effects of the loss of essential fluid and salts. With the tube passed into the lower reaches of the small bowel this disadvantage is overcome for most of the absorptive area lies above the point from which suction is exerted; nutrition can thus be maintained by oral feeding alone (17). This advantage is also present in the cases in

which enterostomy has been performed for acute intestinal obstruction.

During the past year 33 cases of distention in children have been treated by means of gastrointestinal intubation at the Children's Hospital of Michigan and the Detroit Receiving Hospital (Table I). As might be expected, the majority of these resulted from appendicitis, probably the most frequent cause of severe ileus in children.

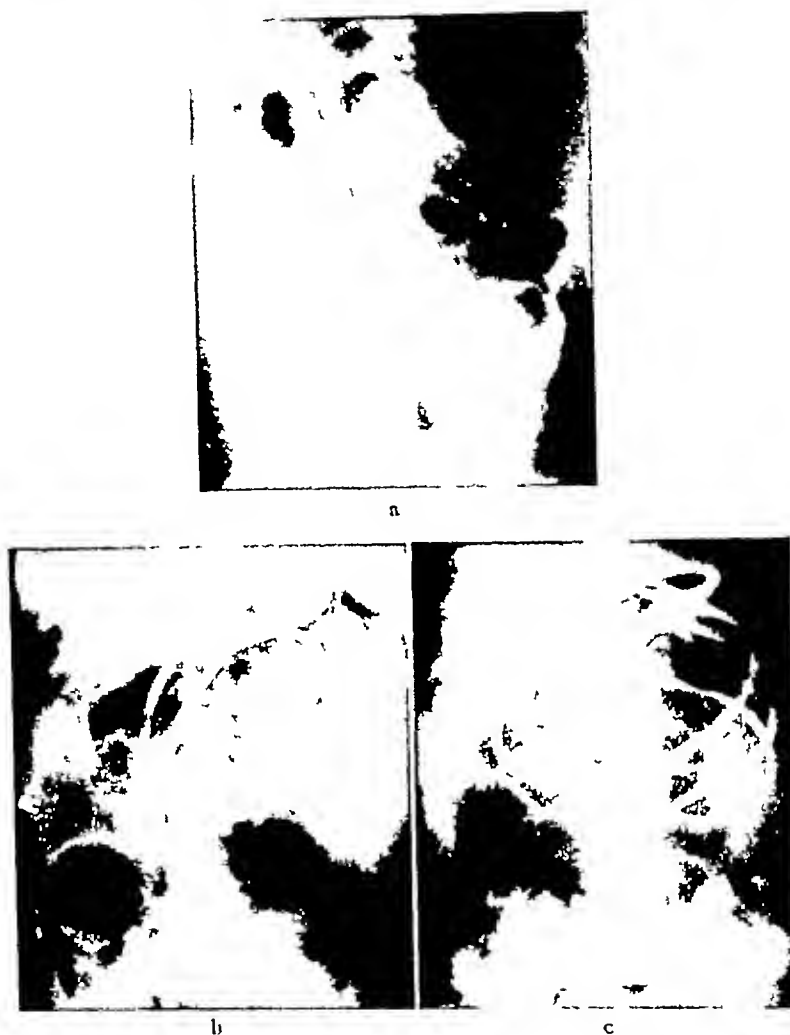


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peritonitis. The series treated by intubation also includes 5 cases of distention from other causes (Table I).

All but one of these cases were successfully decompressed in 1 case of tuberculous peritonitis the distention was only partially controlled, but sufficiently so to prevent its being a determining factor in the eventual outcome. It is worthy of note that a balloon tipped tube lying in either stomach or duodenum will provide drainage from these areas equal in efficiency to Levin or Wangensteen tubes and it has the added advantage that it can be passed further down the intestine when *gastroduodenal drainage* is inadequate. In this series gastric and/or duodenal suction was effective in 22 cases (66.7 per cent) while in 11 (33.3 per cent) relief was obtained only when the tube tip had been passed into or beyond the jejunum (Table IV).

The following cases illustrate the use of intestinal intubation in the treatment of ileus in children.

C. P. A 1 year old boy suffered gunshot wound of the abdomen, 1 1/2 through and through perforation of the stomach. Immediate surgery as carried out and the boy developed moderately severe degree of abdominal distention after operation, despite gastric suction instituted immediately after operation. It was successfully decompressed by means of a tube passed into the small intestine which remained in place for 6 days. An associated fracture of the body of the second lumbar vertebra may have been contributory to the development of the ileus.

E. D. (Fig. 1) A 1 year old boy developed generalized abdominal pain associated with nausea and vomiting, 3 days before admission. The pain localized to the right lower quadrant. Following an emetic and cathartic his pain decreased for a few hours the day before admission, then increased with more severity. When he entered the hospital the entire abdomen was tender and tense, and the boy appeared very ill. His distention was moderately severe and diagnosed as acute diffuse peritonitis with associated adynamic ileus. He was treated conservatively, his distention controlled by intestinal intubation. The boy made good recovery and left the hospital to return later for an interval appendectomy. Undoubtedly the control of his distention was a material factor in the favorable outcome of his peritonitis.

B. A. R. (Fig. 2) A 5 year old girl developed periumbilical pain, nausea, and vomiting the day before admission to the hospital. She was admitted with temperature of 100 degrees with marked abdominal distention, generalized pain, and rigidity. A diagnosis of diffuse peritonitis with associated adynamic ileus was made, and conservatively treatment was decided upon. She was successfully decompressed by means of intestinal intubation and her peritonitis subsided. She was discharged from the hospital in good condition to return later for an interval appendectomy. Undoubtedly the control of her distention was a definite factor in her recovery from the peritonitis.

K. M. (Fig. 3) An 8 year old girl boy suffered generalized abdominal pain, ill nausea and vomiting 3 days before admission. His pain localized in the right lower quadrant during the day preceding admission and there was associated diarrhea for 4 hours. Abdominal examina-

tion revealed generalized tenderness and rigidity most marked in the right lower quadrant. Temperature 100.4 degrees, pulse 90. Leucocytes count 14,000 per cent polymorphonuclear cells. A diagnosis of acute appendicitis with perforation and early peritonitis was made.

Immediate operation was carried out and ruptured gangrenous appendix was removed. His postoperative course was reasonably good until the second postoperative day when abdominal distention became quite marked. This was controlled by gastroduodenal suction, but the distention recurred on the eleventh postoperative day. Three days of gastroduodenal suction was ineffective in controlling the distention, and a balloon-tipped tube was passed on the fifteenth postoperative day. The patient's condition was markedly improved the following day with the tip of the tube lying in the intestine. Complete decompression was rapidly accomplished and the balloon-tipped tube was removed 3 days after its insertion. Patient recovered thereafter uneventfully.

#### SUMMARY

1. Adynamic ileus is a serious condition in children, who stand distention less well than adults. A brief summary of methods for combating distention is given.

2. Evidence is presented for the viewpoint that gastro-intestinal suction drainage is the most logical and effective of these methods.

3. Intestinal intubation is practical in children and is often more easily accomplished than in adults. Having all the advantages of gastric or duodenal tubes it is frequently effective when these methods fail.

4. Appendicitis and its complications are the most common causes of severe ileus in children. The incidence of distention is directly proportional to the extent of the disease.

5. Thirty-three children with marked distention have been decompressed 22 by suction from the stomach or duodenum and 11 by small intestine intubation. In many of these cases control of the distention has been the factor determining the successful outcome.

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## SUPERNUMERARY TARSAI SCAPHOIDS

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THE extra scaphoid of the foot has instigated considerable investigation since this small supernumerary bone lying below (ventral) or medial to the scaphoid, is capable of and does cause symptoms. Its identity is frequently in dispute because of its similarity to the sesamoids so often found in the feet. This, however, is not a sesamoid, for often it has a capsule and a cartilaginous joint surface.

The supernumerary bones arise in antiquity, and are correctly called "atavistic defects." Kidner has suggested that these may represent a sixth toe as in the opossum. Jaboulay thinks that they may be epiphyses for the scaphoids, as the os calcis have epiphyses. This cannot always be true since as mentioned the distal extra scaphoid may have a true joint surface. Certainly in the 2 month fetus the extra bones are a normal finding. For many years following this,

the bone is lost until it becomes visible as an x-ray finding from the ninth year onward. Few children come to the anatomical laboratory and we can obtain no valuable evidence concerning its existence in the early years of life. All extra scaphoids are not separated from the major mass of bone. We have seen a supernumerary scaphoid on one foot, while the contralateral foot showed nothing but an enlarged and hooked scaphoid. We feel that this is simply fusion of the two masses. Occasionally the mass will be only partly fused, and broken line will represent the old joint. If sufficient anatomical evidence could be obtained, perhaps we should find that all children have extra scaphoids, or perhaps some of the refractory flat feet are due to a supernumerary bone which cannot be shown by x-ray examination.

We have some evidence that it is found in families. We have seen it several times in mother



Fig. 1. Left, Extra scaphoid which presents some radiological evidence of localized Kohler's disease. Simple removal resulted in symptomatic cure.

Fig. 2. Supernumerary scaphoid where medial position resulted in localized painful bones.



Fig 3 Left, A posterior type of supernumerary scaphoid. On removal of this extra scaphoid a true degenerative (hypertrophic) arthritis was found in the true joint line. Right, Extra scaphoid, fused to the main body. These are capable of producing all the symptoms attributable to extra scaphoids except those due to degenerative arthritis.

and daughter, but never in father and daughter. It is impossible to get a familial series from x-ray findings alone, so these figures can only indicate and not prove a definite inheritance of this disorder.

How often does it occur? Again we must fall back on x-ray findings. Geist found that it occurred 14 times in 100 cases of presumably normal feet. We find it surprisingly often, but then our patients are x-rayed because of foot disorder, and do not have normal feet. It would seem worthless research to determine the exact number, for either the extra scaphoid causes symptoms or it does not. We know that it does not always cause pain, since we have found this adventitious inhabitant in roentgenograms taken for purposes other than painful feet.

Why does it cause symptoms? Here many theories are given and the majority abandoned. An early theory proposed by Monahan was that this bone developed in flat feet. This is simply the cart before the horse. Flat feet do accompany extra scaphoids, but probably as a result of the extra scaphoid. We have noted, but not proved, that these extra bones are found in the long, narrow foot. We have never seen them in a short broad foot, and this supports the theory that

their presence is needed to support an evolutionary degenerating arch. Perhaps there is a grain of truth in this, or, conversely, the evolutionary degenerative arch is accompanied by these extra bones. We don't know. A third reason for pain is that the extra scaphoid initiates a bursitis by reason of a mechanical irritation. This does occur, and we have seen it. Kidner believes that the extra mass of bone pushes against the internal malleolus, causing pain. He further believes that adduction of the forefoot follows the attempt to escape this pressure, with the natural results of such adduction—flat-foot. The interesting theory of change at direction of muscle pulls and mechanical disadvantage are brought up, and on these are postulated some of the surgical treatments. Burman and Lapidus quote Kidner as stating that Kohler's disease may occur in this extra bone. They present a case which may confirm this. Finally, degenerative (traumatic) arthritis is mentioned as a cause of symptoms in this disorder.

It seems that the presence of extra tarsal scaphoids is sometimes accompanied by pain. Further, it has been shown that operative treatment relieves the pain, so it is logical to think that the supernumerary bones are a primary cause of



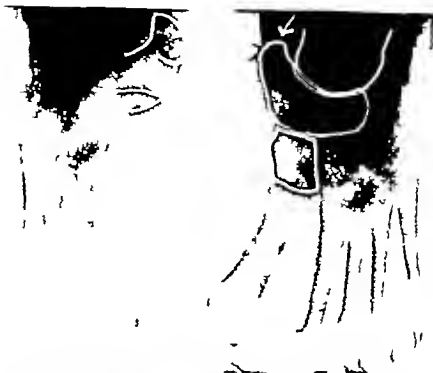


Fig. 4. Left, Partially fused extra scaphoid as shown by the incomplete joint line. Does this indicate that these fuse more easily than is believed?

Fig. 5. Large extra scaphoid, which is fused to the body of the true scaphoid. The soft tissue mass over the medial posterior end of the scaphoid indicates a painful bone.

atarsalgia. We feel that the pain here present must be divided into 4 categories. First, that resulting from faulty mechanics of the foot; second, that due to mechanical pressure from the shoes, as a bursitis; third, that pain which results from a traumatic synovitis of the posterior tibial tendon, as in deQuervain's disorder of the wrist, and finally that arthralgia which comes from a degenerative arthritis in a mal-placed and ad-junction joint.

The disorder therefore can be roughly grouped into 3 age periods—those disabilities of immature years and those of the degenerative phase of life. In childhood, refractory flat feet may be due to unossified extra scaphoids. Here the posterior tibial tendon is carried so obliquely as markedly to decrease its effective pull. We have seen such cases in which the final diagnosis was made only after several years, and after effective identification of the ossifying extra scaphoid. Theoretically such a mal-used extra scaphoid in accordance with Wolff's law should ossify early. Certainly the presence of a bony mass which con-

stantly impinges on the encasing shoe will cause bursitis and pain. The tenosynovitis, manifested by very localized pressure pain, will be found in the early age group and in the later group if initiated by intolerable exertion. In the later group despite the chronological age degenerative arthritis in the mechanically looped joint may result and will cause pain on the slightest exertion.

Fortunately in the major portion of life that is from the ninth year on the extra scaphoid can be found on x ray examination. Early, however it cannot. But a well treated case of early refractory mid-foot pain should, after a few years, demand surgical investigation. In the proved case the pressure of this mechanical impediment will demand intervention.

Several operations have been advised. Kibler in 1929, suggested that the aberrant attachment of the posterior tibial tendon be transferred to the true scaphoid and the extra piece removed. Others believe that simple removal of the extra scaphoid is sufficient. We also are of the opinion that simple removal of the extra scaphoid or

scaphoids is effective. The tendon early attaches itself to the surgically traumatized area, and the slack is taken up by modifications of muscle pull. Such a simple procedure has resulted, in all of our cases, in symptomatic cure with bettered foot mechanics.

Finally, it must be remembered that an extra scaphoid is not always detached from the mother bone. The long-hooked process which represents a fused supernumerary bone will cause all symptoms, save those of localized arthralgia, that will a free extra scaphoid.

#### CONCLUSIONS

- 1 Extra scaphoids are not rare.
- 2 Certain of these will cause symptoms of, or predispose to, flat-foot.
- 3 Certain of these will develop a hypertrophic arthritis in their true joint space.
- 4 Certain cases of refractory flat foot before the ages of 8 or 9 years are due to the presence of extra scaphoids.
- 5 These cases, despite the negative x-ray findings, should, after adequate conservative treatment, be explored surgically.

6 The painful bursitis, or the localized tenosynovitis concomitant with extra scaphoids, can be cured only by surgical repair.

7 The hypertrophic change, so common in the joints of these extra scaphoids, can be cured only by removal of the extra scaphoids.

8 The simple removal of the extra scaphoid and placement of posterior tibial tendon to a better mechanical position will, without further procedure, result in symptomatic cure.

9 The presence of a deformed, pain-producing scaphoid, even without extra bodies, is indication for a plastic repair.

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# THE SURGICAL TREATMENT OF HYPOSTOSING MENINGIOMAS OF THE SPHENOID WING

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IF meningiomas as a group as well as each individual type have become much better understood since the results of an exhaustive study of a lifelong experience were recorded by Cushing and Eisenhardt.

In this presentation the authors wish to include only one branch of the meningiomas commonly known and spoken of by most neurosurgeons as the sphenoid wing meningiomas. Limited still further will be the surgical considerations and technique for the removal of the *en plaque* tumor of the sphenoid ridge.

It is necessary to keep in mind the anatomy of the skull in the region of the sphenoid wing so that the symptoms produced by these tumors as well as the operative considerations may be more fully appreciated (Fig. 1). It is imperative for the surgeon to have a thorough understanding of the anatomical relationships, not only so that the actual removal of these tumors may be made less hazardous but also so that the roentgenograms may be properly interpreted.

No words could more adequately and briefly describe the sphenoid ridge than those used by Cushing. Sharply demarcating frontal from middle fossa, a bony ridge curves onward on a horizontal plane from anterior clinoid process toward the lateral aspect of the cranial chamber where it flares out to become lost in the pterional region of the cranial vault. The sphenoid ridge may be readily divided into three parts: (1) deep inner or clinoid; (2) middle or alar; (3) outer or pterional. The inner two-thirds roughly correspond to the posterior margin of the lesser sphenoid wing (*ala parva*); the outer third to the flaring margin of the greater wing (*ala magna*). To visualize properly the intracranial topography of the region requires exceptional three dimensional sense for here come together the surfaces of three bony planes: (1) that of the orbital roof of an obliquely horizontal plane; (2) the rough vertical aspect of the middle temporal fossa in coronal plane; and (3) the vertical but obliquely placed outer wall of the orbit.

Since the symptoms depend greatly on the location of the point of origin of these tumors on the sphenoid ridge Cushing saw fit to classify them as deep, middle, or pterional *en plaque* sphenoid ridge meningiomas.

The deep or clinoid tumor usually manifests itself subjectively by unilateral diminished vision and objectively by pallor of the optic nerve head and nasal hemianopsia. As it enlarges there is complete blindness on the involved side with homonymous defect in the other eye with possible beginning or frank choking of the optic nerve head and complete primary atrophy on the tumor side. Exophthalmos occurs with bone erosion and invasion of tumor into the retrobulbar space but it may occur from pressure on the cavernous sinus and subsequent venous engorgement. Because of the proximity of the superior orbital fissure, varying degrees of oculomotor palsies occur on the side on which the lesion is located. The most common nerve involved is the sixth, although complete ophthalmoplegia may develop. Local discomforts usually occur late. Other signs of local extension may be manifested by olfactory or gustatory hallucinations, mental changes, polydipsia and polyuria, and paralysis of the opposite side. Finally the roentgenograms may show erosion or hyperplasia of bone.

In contradistinction the deep or clinoid tumors the middle tumor first manifests itself by evidences of increased intracranial pressure and until it has attained such a size that extension across the midline occurs, as happens in some cases, no symptoms other than mental changes may be noted. The roentgenograms may demonstrate erosion proliferation or no change therefore studies with injection of air frequently have to be carried out to verify the site of the tumor.

The type of tumor most satisfactorily treated from the surgeon's standpoint is the pterional *en plaque* which I wish to discuss both as to the symptoms it produces and from surgical aspect. The frequency of these tumors is demonstrated by the fact that only 19 were seen by Dr. Cushing in over 2,000 verified brain tumors. Peculiarly enough, all of the 19 occurred in women and Dr. Cushing knew of only 3 reported examples in

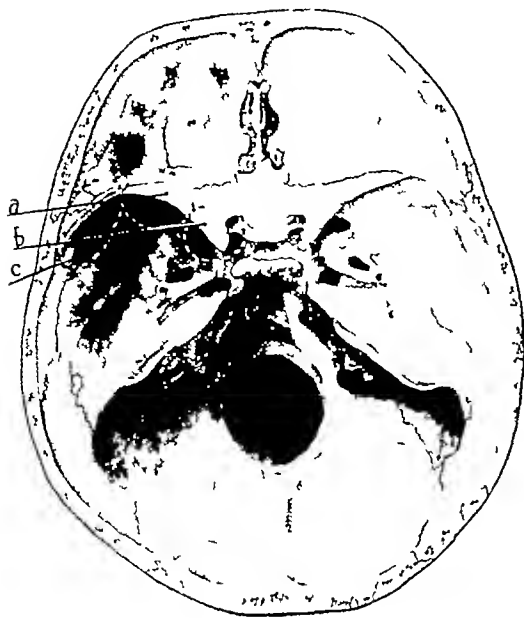


Fig 1 Normal anatomy of base of skull in relation to the sphenoid wings. The circles outline approximately the regions from which sphenoid wing meningiomas arise most frequently a, Alar, b, chnoidal, c, pterion (From Spalteholz' *Anatomy*, Vol 1)



Fig 2 Typical photomicrograph of sclerotic bone invaded by tumor cells

men In our group of 10 cases, 1 was a male (Case 5, Fig 6). The diagnosis is readily made from a history of slowly developing exophthalmos with diminished vision on the affected side, swelling in the temporal region, frontal headache, and pain in the region of the orbit. The impairment of vision may occur late in the course of the disease, however, the frontal headaches and pains around the eye may be severe early and tend to decrease as the bone continues to become thicker. Varying degrees of exophthalmos may be found on examination, depending on the extent of the tumor. The affected eyeball may be only 2 millimeters or it may be many millimeters more prominent than the other eyeball. If exophthalmos is marked, the conjunctiva is congested and edematous. The exophthalmos is irreducible, non-pulsating, and displaced forward and downward. The optic nerve head is pale, with engorgement of the vessels. There may be fullness and tenderness of the temporal muscle (probably invasion of tumor into muscle).

Roentgenograms verify the diagnosis since they demonstrate an eburnation of the pterional region. In the very early cases (Case 4, Fig 8), the

anteroposterior and postero-anterior views are of particular value.

The hyperostotic effect of these tumors may be exceedingly great (Case 9, Fig 9) and the production of soft tumor slight so that in many cases the latter is manifested only by a thickened dura with a thin layer of red granular tissue a few millimeters or more in thickness. A globular tumor was produced in only 1 of our cases. Why meningiomas of this type affect the bone in this way has been unexplained. The microscopic appearance of the *en plaque* meningiomas is fairly uniform (Fig 2), in only a few the bone is so densely eburnated that no tumor invasion can be seen.

Even though it has been shown that this type of tumor is relatively uncommon, nevertheless it is one of the most important to recognize and treat early. It is notoriously slow in growth and therefore considerable hesitancy has been felt by many neurosurgeons in advising these patients to be subjected to early surgical intervention. Since a relatively incomplete removal often gave the

# THE SURGICAL TREATMENT OF HYPEROSTOSING MENINGIOMAS OF THE SPHENOID WING

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THE meningiomas as a group as well as each individual type have become much better understood since the results of an exhaustive study of a lifelong experience were recorded by Cushing and Eisenhardt.

In this presentation the authors wish to include only one branch of the meningiomas commonly known and spoken of by most neurosurgeons as the sphenoid wing meningiomas. Limited still further will be the surgical considerations and technique for the removal of the *en plaque* tumor of the sphenoid ridge.

It is necessary to keep in mind the anatomy of the skull in the region of the sphenoid wing so that the symptoms produced by these tumors as well as the operative considerations may be more fully appreciated (Fig. ). It is imperative for the surgeon to have a thorough understanding of the anatomical relationships, not only so that the actual removal of these tumors may be made less hazardous but also so that the roentgenograms may be properly interpreted.

No words could more adequately and briefly describe the sphenoid ridge than those used by Cushing. Sharply demarcating frontal from middle fossa, a bony ridge curves outward on horizontal plane from anterior clinoid process toward the lateral aspect of the cranial chamber where it flares out to become lost in the pterional region of the cranial vault. The sphenoid ridge may be readily divided into three parts: (1) deep inner or clinoid, (2) middle or alar, (3) outer or pterional. The inner two-thirds roughly correspond to the posterior margin of the lesser sphenoid wing (*ala parva*); the outer third to the flaring margin of the greater wing (*ala magna*). To visualize properly the intracranial topography of the region requires exceptional three dimensional sense, for here come together the surfaces of three bony planes: (1) that of the orbital roof of an obliquely horizontal plane, (2) the roughly vertical aspect of the middle temporal fossa in coronal plane, and (3) the vertical but obliquely placed outer wall of the orbit.

Since the symptoms depend greatly on the location of the point of origin of these tumors on the sphenoid ridge, Cushing saw fit to classify them as deep middle, or pterional or *en plaque* sphenoid ridge meningiomas.

The deep or clinoid tumor usually manifests itself subjectively by unilateral diminished vision and objectively by pallor of the optic nerve head and nasal hemianopsia. As it enlarges there is complete blindness on the involved side with homonymous defect in the other eye with possibly beginning or frank choking of the optic nerve head and complete primary atrophy on the tumor side. Exophthalmos occurs with bone erosion and invasion of tumor into the retrobulbar space but it may occur from pressure on the cavernous sinus and subsequent venous engorgement. Because of the proximity of the superior orbital fissure, varying degrees of oculomotor palsies occur on the side on which the lesion is located. The most common nerve involved is the sixth, although complete ophthalmoplegia may develop. Local discomforts usually occur late. Other signs of local extension may be manifested by olfactory or gustatory hallucinations, mental changes, polydipsia and polyuria and parosmia of the opposite side. Finally the roentgenograms may show erosion or hyperplasia of bone.

In contradistinction to the deep or clinoid tumors, the middle tumor first manifests itself by evidences of increased intracranial pressure and until it has attained such a size that extension across the midline occurs as happens in some cases, no symptoms other than mental changes may be noted. The roentgenograms may demonstrate erosion, proliferation, or no change; therefore studies with injection of air frequently have to be carried out to verify the site of the tumor.

The type of tumor most satisfactorily treated from the surgeon's standpoint is the pterional or *en plaque* which I wish to discuss both as to the symptoms it produces and from a surgical aspect. The frequency of these tumors is demonstrated by the fact that only 9 were seen by Dr. Cushing in over 3000 verified brain tumors. Peculiarly enough all of the 9 occurred in women and Dr. Cushing knew of only 3 reported examples in

From the Department of Neurosurgery, The Liley Clinic, Cushing and Eisenhardt Meningiomas, Springfield, Ill., Charles C. Thomas, 1934.

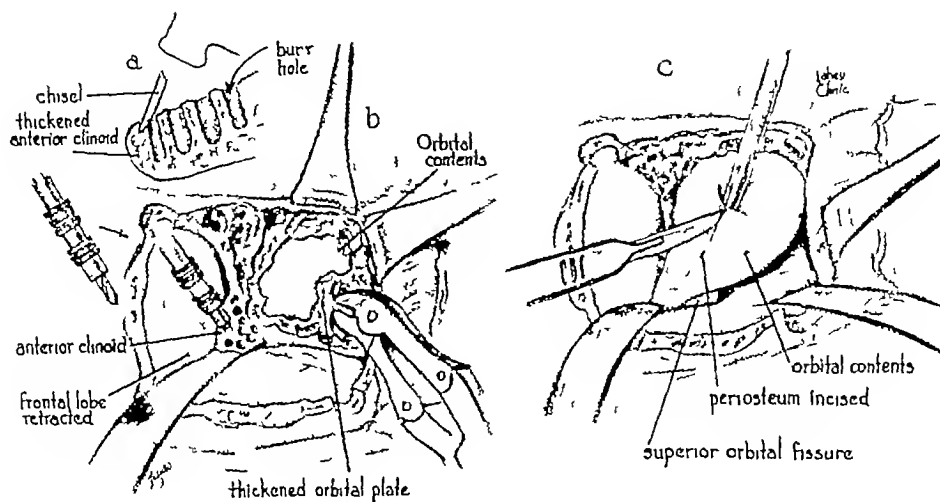


Fig 4 a, Anterior clinoid greatly weakened by honeycombing with specially built burr which is electrically driven. Small fragments chipped away with mallet and chisel. b, Orbital perosteum and contents beginning to appear. c, Periosteum and orbital fascia incised. Demonstration of dura over temporal lobe and superior orbital fissure.

hazardous. To remove the bone safely, a special drill about 2 millimeters in thickness was made with an adjustable sleeve so that the depth could be readily gauged. With this drill attached to the electric motor many small openings are made 2 or 3 millimeters apart, within a few millimeters of the entire thickness of the bone. The greatly weakened structure is then removed by the judicious use of the mallet and chisel, small fragments breaking off without much jar or danger of breaking into a sinus. In this manner the entire anterior clinoid is removed, and the superior orbital

fissure and optic canal are left well decompressed (Fig 5, a). The orbital capsule is then widely opened and the intra-orbital tissues are allowed to protrude. They are examined for the presence of tumor. The incision should start over the annular ligament of Zinn and be carried upward, since in this way the protruding tissues do not interfere with completing the opening of the capsule. The dura is opened and if tumor is present it is removed or if only a thin, granular layer of tumor is present it is thoroughly eschared with electrocoagulation.

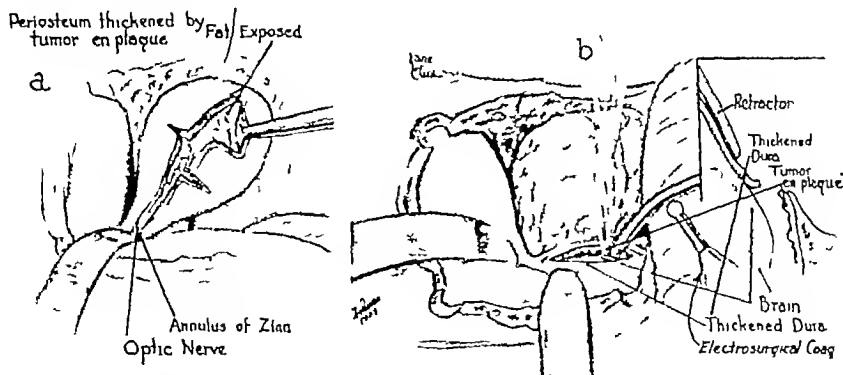


Fig 5 a, Exposure of orbital contents by incision in periosteum. Demonstration of thin layer of tumor *en plaque* which may occur intra-orbitally as well as intracranially. b, Periosteum and tumor removed, showing herniation of orbital fat. Incision in dura at sphenoid groove demonstrating granular tumor being coagulated with electric surgical unit.

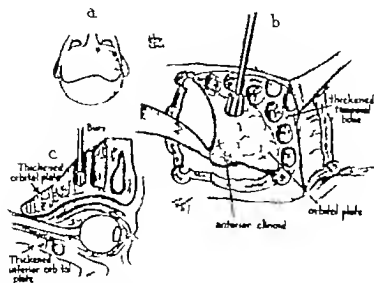


Fig. 3. a, Modified coronal incision with osteoplastic flap outlined. b, Greatly thickened pterional plate, orbital bone, and anterior clinoid demonstrating multiple burr openings. c, Greatly thickened orbital plate and inferior orbital plate with outlines of burr openings.

patient years of relief. It was considered unwise to perform any radical procedure to remove the tumor. In advanced cases, the hazards of radical extirpation naturally increase and therefore as soon as the diagnosis can be made, wide removal of all the involved bone as well as the entire sphenoid wing and orbital plate should be executed.

Since in our experience the recession of the eye ball, after surgical treatment of malignant exophthalmos of thyroid disease, was directly proportional to the amount of internal decompression of the orbit, the technique described by Naffziger was modified by removing the sphenoid wing and lateral wall of the orbit as well as the orbital plate. These experiences introduced and systematized the technique now used in the hyperostosing sphenoid ridge meningiomas.

Briefly, the operation is performed by making a modified coronal incision (Fig. 3 a). The scalp is reflected anteriorly and a moderate sized frontal osteoplastic bone flap is turned down toward the temporal region, breaking it as low on the temporal muscle as possible. The dura is separated from the orbital plate posteriorly well over the greatly thickened sphenoid ridge, optic canal, and anterior clinoid, and also along the temporal bone laterally. The temporal muscle if not invaded with tumor is separated from the

bone on the lateral surface of the orbit and pterional region. The thickened bone is now removed with giant rongeurs as deeply toward the triangle of the ala magna as possible. The greatly thickened and broad surface is honey-combed with the electric drill and the interlacing remnants of bone removed with rongeurs (Fig. 3, b). The orbital plate is then removed with the use of the electric drill and rongeurs, care being taken that the orbital capsule is not injured since if it is unintentionally opened, considerable embarrassment is experienced because of the protrusion of fat tissue. Since the inferior wall of the orbit as well as the lateral walls is also greatly thickened in the advanced cases, the burr can again be used to great advantage, the burr openings being made close to each other so that the partitions left may be readily removed with the rongeur (Fig. 4). In this manner all the bone may be removed from the orbital roof, side wall, and greater sphenoid wing to the superior orbital fissure. The portion of greatly thickened bone which covers the optic foramen and the greatly thickened anterior clinoid remain. In a few patients the hyperostosis over the anterior clinoid may resemble a turret and be to 3 centimeters in thickness. It can be readily understood that if any of the vision is to be restored this bone must be removed, and this step naturally is the most



Fig 7 Front and profile views of Cases 7, 8, 9, and 10 both before and after operation Case 9 demonstrates the advanced stage

metic results were not noteworthy, it is fair to assume that by the procedure outlined satisfactory cosmetic results as well as permanent relief of visual disturbances from tumor will be afforded the patient. Ten brief case reports are submitted, with photographs taken before and after operation. The photographs and roentgenograms may be readily compared (Figs 6, 7, 8, and 9).

#### CASE REPORTS

**CASE 1** A woman, aged 62 years, was admitted to the clinic on October 11, 1937, and was discharged on November 8, 1937. The patient first noted protrusion of the left eye in 1917. This very slowly increased and she was finally operated upon by Dr. Harvey Cushing in 1929. Some subsidence of the eye followed the operative procedure but gradually protrusion again occurred and was accompanied by a gradual loss of vision so that for several years the patient has been practically blind in that eye. Her general health had been fairly good and there were no special complaints other than those noted.

Examination revealed a marked protrusion of the left eye as compared with the right, with marked edema of the eyelids and soft tissues under the eye. The right fundus was normal, the left showed extreme atrophy. The exophthalmometer readings before operation were: base line, 99, right eye, 18 millimeters, left eye, 32 millimeters, acuity in the right eye was 20/20, in the left, nil. The right visual field was normal.

Operation was performed on October 14, 1937. A right transfrontal craniotomy was carried out with radical removal of greatly thickened and involved bone, muscle, dura, and tumor that invaded the orbital contents after the thickened orbital roof had been taken away.

The exophthalmometer readings following operation were: base line, 99, right eye, 18 millimeters, left eye, 17 millimeters. When last seen in February, 1938, the patient was doing well and improving.

**CASE 2** A woman, aged 43 years, was admitted to the clinic on June 25, 1937, and was discharged on July 21, 1937.

The patient first noted protrusion of the right eye in March, 1937. She complained of headache in the right temporal region of 2 months' duration. She had no other



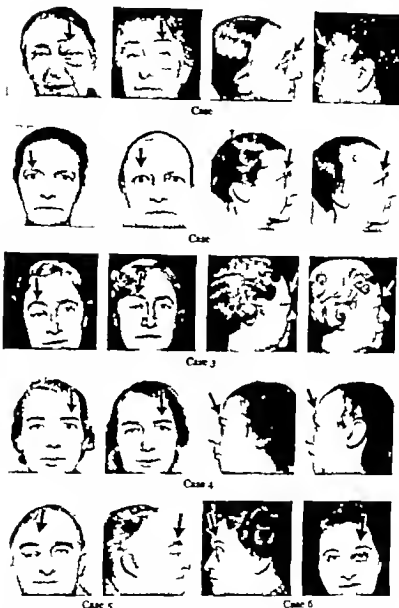


Fig. 6. Front and profile views of Cases 1, 2, 3, 4, 5, and 6 in this series both before and after operation, with exceptions. Case 5 is shown only before operation, which terminated fatally from sepsis. In Case 6 only the photographs taken after operation are available. Cases 3 and 5 demonstrate the advanced stages.

In conclusion, emphasis should be placed on the fact that every patient with unilateral exophthalmos should have a thorough physical and neurological examination, including roentgenograms of the skull, to verify the diagnosis of pterional *en plaque* meningioma. Early complete removal

of involved bone and dura is the procedure of choice. This surgical procedure has been illustrated and advised as a practical method and is used in our department at the present time. Since formerly incomplete operations were carried out with long periods of relief even though the con-



Case 9



Case 7



Case 4

Fig 9 Lateral roentgenograms taken before and after operation, demonstrating hyperostosing meningiomas of the sphenoid wing in Case 9, advanced, Case 7, moderately advanced, and Case 4, early stages. Compare with anteroposterior views in Figure 8

pared with the left and there was marked prominence of the supra orbital ridge on the right side. The general appearance of the disks was good, the right disk however, was slightly atrophied. Visual acuity in the left eye was 20/30, in the right, 20/50, visual fields were normal. Examination of the x ray films of the skull showed thickening of the right sphenoid ridge with increased density of the right sphenoid bone and adjacent frontotemporal bones. The right supra-orbital fissure was markedly narrow. The frontal bone was involved to the right margin of the frontal sinus.

Operation was performed on March 10, 1938. A recurrent meningioma was removed from the lateral region and temporal muscles. To accomplish its removal the orbit was unroofed and the frontal sinus was opened.

Death occurred, due to an acute meningitis which developed after operative removal of recurrent meningioma.

CASE 6 A woman, aged 46 years, was admitted to the clinic on March 12, 1937, and on May 9, 1937, and was discharged on March 22, 1937, and on June 19, 1937.

In March, 1934, beginning lacrimation of left eye was noted. In July, 1934, lacrimation continued and a begin

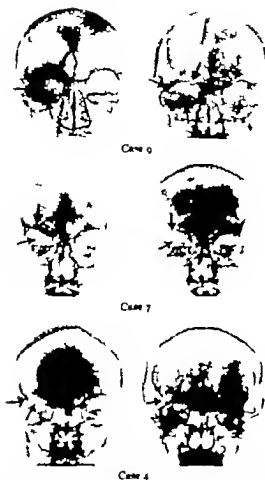


Fig. 8 Anteroposterior roentgenograms taken before and after operation, demonstrating hyperostotic sphenoidosis of the sphenoid wing in Case 6, advanced, Case 7 moderately advanced, and Case 4, early stages. Compare with lateral lens in Figure 9.

special complaints except that she had not felt ery cell for years. There was no loss of vision.

Examination revealed slight right exophthalmos. The exophthalmometer readings before operation were base line right eye 8 millimeters left eye 6 millimeters. The fundi were normal. Visual fields and acuity were normal. X-ray examination of the skull showed increased density of the right sphenoid wing compared with the left.

Operation as performed on June 20, 1937. A transfrontal craniotomy was carried out with extensive removal of thickened and involved bone involving the roof of the orbit, together with removal of involved dura.

The exophthalmometer readings following operation were base line right eye 8 millimeters left eye 6 millimeters. When last seen in February 1941 the patient was in excellent condition.

Case 3. A woman, aged 5 years, came to the clinic on July 7, 1933 and was discharged on August 10, 1933. The

patient first noted protrusion of the right eye in 1931. This had at times progressed and at times receded somewhat. Vision had been poor in the right eye for many years. The patient's condition was followed for 5 years. Her repeated x-ray examinations of the skull in 1932, 1937 the patient was followed for a second time by Dr. Calkins and because of an increase in the exophthalmos an operation was advised.

Examination proved negative except that of the eyes and x-ray films. There was marked protrusion of the right eye and fullness of the right temporal region. The exophthalmometer readings before operation were base line right eye 8 millimeters left eye 6 millimeters. There was marked optic atrophy of the right fundus, the left was normal. Visual acuity in the right eye was 20/200, in the left, 20/20. Examination of the x-ray films showed great thickening and increased density of bone involving the orbital plate and contiguous sphenoid and temporal region.

Operation performed on July 9, 1937. A right transfrontal craniotomy was carried out with removal of meninges that is of the bone over the orbit and the sphenoid region together with large intradural meningioma. Each weighed 5 grams, for the removal of which was necessary to take off the tip of the frontal lobe. Tumor was also present within the orbit.

The exophthalmometer readings after operation were base line right eye 8 millimeters left eye 6 millimeters. When last seen on February 8, 1941, the patient was ery cell. She had resumed her usual teaching position in September 1937. The right eye had receded to normal.

Case 4. A woman, aged 5 years, was admitted to the clinic on November 27, 1937 and discharged on December 24, 1937. She complained of increasing headaches in the left temporal and orbital region and on the left side of the head since August, 1936. These had become progressively worse. She had noted protrusion of the left eye which had persisted for the same period. Patient also complained of having had double vision for months before admission.

Examination revealed definite exophthalmos on the left with tenderness of the palpebral fissure. The fundi, bowel fields and acuity were normal. The exophthalmometer readings before operation were base line right eye 6 millimeters left eye 8 millimeters. Examination of the x-ray films revealed thickening and increased density of the left sphenoid wing.

Operation as performed on November 29, 1937. A left transfrontal craniotomy was carried out with removal of thickened bone in and with tumor as present in the dura.

The exophthalmometer readings following operation were base line right eye 7 millimeters left eye 6 millimeters.

Case 5. A man, aged 47 years, was admitted to the clinic on February 2, 1938 and died on March 4, 1938.

Patient complained of protrusion of the right eye of 3 years duration. In 1936, he suffered an injury to the right side of the head. Shortly after this thickening of right frontal region noted. A craniotomy as performed in 1936 at which bone tumor and neighboring bone was completely removed. The eye gradually protruded after operation still in 1937 it was nearly dislocated from the socket. The patient had had convulsions in April, 1935 and in January 1937. His health otherwise was good.

Examination revealed marked protrusion of the right eye. Marked depression was present on the right as cor-



Case 9



Case 7



Case 4

Fig 9 Lateral roentgenograms taken before and after operation, demonstrating hyperostosing meningiomas of the sphenoid wing in Case 9, advanced, Case 7, moderately advanced, and Case 4, early stages. Compare with anteroposterior views in Figure 8.

pared with the left and there was marked prominence of the supra-orbital ridge on the right side. The general appearance of the disks was good, the right disk, however, was slightly atrophied. Visual acuity in the left eye was 20/30, in the right, 20/50, visual fields were normal. Examination of the x-ray films of the skull showed thickening of the right sphenoid ridge with increased density of the right sphenoid bone and adjacent frontotemporal bones. The right supra-orbital fissure was markedly narrow. The frontal bone was involved to the right margin of the frontal sinus.

Operation was performed on March 10, 1938. A recurrent meningioma was removed from the lateral region and temporal muscles. To accomplish its removal the orbit was unroofed and the frontal sinus was opened.

Death occurred, due to an acute meningitis which developed after operative removal of recurrent meningioma.

CASE 6 A woman, aged 46 years, was admitted to the clinic on March 12, 1937, and on May 9, 1937, and was discharged on March 22, 1937, and on June 19, 1937.

In March, 1934, beginning lacrimation of left eye was noted. In July, 1934, lacrimation continued and a begin-

ing protrusion of left eye as noted for the first time. I March, 1936, the patient as seen by Dr. Cushing. X-ray films of the skull taken at that time showed bony thickening, but no operation as advised. I January, 1937 the patient as again seen by Dr. Cushing. Some failure of vision in the left eye and further thickening of the bone were noted. Operation as advised.

Examination in March, 1937 as negative, except for the eyes. There as an obvious protrusion of the left eye as compared with the right. The exophthalmometer readings before operation are base line, right eye, 7 millimeters, left eye, 5 millimeters.

The right fundus as normal in the left, the disk outline as blurred and the disk as reddened. The fundi fields are normal. Visual acuity in the right eye as 20/30. In the left, 20/40. Examination of the x-ray films revealed thickening of the bone of the orbital roof and lateral all of the orbit as well as of the sphenoidal wing.

Operation as performed on May 3, 1937 (postponed because of upper respiratory infection). A left trans-frontal craniotomy as carried out with extensive removal of thickened bone. The dura as coagulated over the area, but it as not opened because tumor in the bone had invaded all the ethmoid cells and the latter had been opened at one point.

The exophthalmometer readings on June 8, 1937 are base line, right eye, 9 millimeters, left eye, 5 millimeters.

When last seen in December, 1937 the patient as in excellent condition.

Case 7 A woman, aged 39 years, as admitted to the clinic on June 9, 1937 and discharged on July 1, 1937. She complained of headaches and progressive loss of vision in the right eye for years and of some fatigability.

Examination of the fundi revealed right disk that as pale with primary trophic; the left disk as normal. Visual acuity in the right eye as 5/200 in the left, 20/30. There as marked right exophthalmos. The exophthalmometer readings before operation are base line, 99, right eye, 21 millimeters, left eye, 16 millimeters. Examination of the x-ray films of the skull showed increased density of the right orbit and sphenoidal wing and of the roof and lateral all of the orbit.

Operation, which lasted 5 hours, as performed on June 5, 1937. The brain as under considerably increased pressure, the relief of which necessitated taking off the tip of the frontal lobe. Radical removal as done of all thickened, tumor involved bone, except where the internal carotid vein ran through it. Extirpation of large intracranial tumor as carried out. This as followed by transfusion.

The exophthalmometer readings on July 14, 1937 are base line 97, right eye, 9 millimeters, left eye, 8 millimeters.

When last heard from in letter dated July 30, 1937 patient expressed desire to begin work.

Case 8 A woman, aged 36 years, came to the clinic on July 3, 1935, and as discharged on August 6, 1935. Patient complained of protrusion of the right eye of 6 years duration and discharge from both eyes for years. Since April, 1935, she had had some dimming of vision in the right eye.

Examination revealed definite right exophthalmos, partial ptosis of the right lid, and paresis of the right third and sixth nerves. The right fundus as moderately atrophied. The exophthalmometer readings before operation are base line 66, right eye 20 millimeters, left eye,

8 millimeters. Visual acuity in the right eye as 20/70 in the left, 20/30.

Operation as performed on July 14, 1935. A right frontal craniotomy as carried out with complete extirpation of sphenoidal wing meningioma and thickened and tumor in all of the bone; the base of the orbit as coagulated.

The exophthalmometer readings after operation are base line, 66, right eye, 20 millimeters, left eye, 9 millimeters. Visual acuity in the right eye as 20/100.

When last seen on June 4, 1936, the patient reported that she had resumed her teaching position on February 1, 1936. She as feeling much better; the mild chronic irritation of the eyes as about the same.

Case 9 A woman, aged 55 years, came to the clinic on October 3, 1935, and as discharged on November 5, 1935. This patient had been operated upon by Dr. Harvey Cushing in November, 1918, at which time bone involved in tumor as partially removed. A gradual recurrence took place which resulted in further protrusion of the right eye with considerable conjunctival edema.

Examination revealed marked prominence of the right eye with lacrimation, conjunctival edema, and edema of the eyelids. The right eye as blind, with marked primary atrophy. Movements of right eyeball are limited in all directions. In the left eye the fundus and visual acuity are normal. The exophthalmometer readings before operation are right eye, 3 millimeters, left eye, 5 millimeters.

Examination of the x-ray films revealed an extremely marked thickening and density of the orbital roof and lateral all of the orbit.

Operation as performed on October 23, 1935. A right transfrontal craniotomy as carried out with extensive removal of extremely thick and indurated tumor involved bone and surrounding of the orbit.

The exophthalmometer readings on November 10, 1935 are right eye, 23 millimeters, left eye, 5 millimeters.

When heard from on June 7, 1936, patient stated that with the right eye alone she can now see 1 foot around the house.

The exophthalmometer readings on June 7, 1936 are right eye, 27 millimeters, left eye, 5 millimeters, on December 1, 1937 base line, 99, right eye, 30 millimeters, left eye, 5 millimeters.

Operation as again performed on March 9, 1937. A right frontal exploration as done with extensive excision of recurrent meningioma in the bone and thickening of the orbit.

When last seen on April 1, 1936, the patient felt well and the right eye had receded to normal.

Case 10 A woman, aged 43 years, as admitted to the clinic on June 6, 1936, and discharged on July 1, 1936.

The patient complained of progressive prominence of the left eye for 6 years and headaches for 3 years, which had become progressively worse. Otherwise health as good.

Examination revealed an exophthalmos of the left eye. The exophthalmometer readings before operation are base line, 94, right eye, 10 millimeters, left eye, 16 millimeters. The fundi showed slight temporal defect in the left eye. Examination of the x-ray films revealed large sclerotic bony left sphenoidal wing.

Operation as performed on June 8, 1936, and removal of all sclerotic bone as carried out.

The exophthalmometer readings following operation are base line 94, right eye, 10 millimeters, left eye, 16 millimeters.

When last seen on July 1, 1936, the patient had made complete recovery.

# CAUSES OF DEATH IN CANCER OF THE CERVIX UTERI

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IT has long been our conviction that, with relatively few exceptions, patients harboring malignant neoplasms do not die directly as a result of their cancers. The cancer process initiates a succession of circumstances which eventually kill by secondary pathological manifestations rather than by the primary disease. Unless such secondary effects occur, usually as a result of contiguously invasive or disseminated metastases attacking some vital organ and interfering with its normal function, the patient may live in relative comfort for many years. The short course in cervix cancer is commonly the result of early involvement of neighboring important structures. This study was prompted by the realization that, except in a few major centers handling large volumes, these facts are not adequately recognized. It is presented with a point of view opposite to that usually encountered, in that the data are those of cases in which therapy failed, resulting in death.

This analysis is based upon a review of 1,558 cases of cervix disease seen at the New York City Cancer Institute from 1927 to 1938. In this group were 802 recorded deaths in the institution. Soon after the beginning of our study it was realized that such a mass of material including many incomplete records is of less value than a detailed analysis of the 124 cases for which full autopsy protocols are available. Therefore, although the entire group forms a basis for impressions and judgment as to clinical course, management, and relative values of therapeutic techniques, statistical analysis is made of only the smaller group which represents a cross section of all cases and includes examples of all types.

Primary treatment in these cases was carried out not only at the Institute but by the staffs of the other metropolitan clinics as well as by private practitioners. A comprehensive view of the late results following all types and techniques of treatment is thereby obtained.

## AGE AND INCIDENCE

The total number of new admissions for the 10 year period was 13,454 of which 7,292 were

From the New York City Cancer Institute and Hospital.  
Presented before the Third International Cancer Congress  
Atlantic City, New Jersey, September 15, 1939 and the New  
York Academy of Medicine Section on Obstetrics and Gynecology,  
April 23, 1940.

women. The 1,558 cases of cervix disease represents 11.8 per cent of total admissions and 21.4 per cent of female admissions. This forms the largest single group of admissions classified under any one anatomical subdivision and represents an incidence of malignant disease found in women equivalent to diseases of the breast.

Of a total of 124 cases, 74 patients, or 59.5 per cent, were white and 50, or 40.5 per cent, were colored. Considering the relative proportion of white to colored population in New York City (20 to 1) this is an unusually high degree of incidence in colored women. It must be realized in this connection that our admissions represent exclusively cases in indigent patients, the majority of whom have well advanced disease when first admitted either to our clinic or to other hospitals from which transfer to us was made.

It is notable that the greatest number of patients—40 or 32.2 per cent—are in the fifth decade, between ages 41 and 50. The fourth and sixth decades have the next highest groups—24 and 23 per cent. Four per cent of the cases were seen in the age group 71 to 80 and 8 per cent each fell into the third and seventh decades.

No specific etiological factors were ascertainable. Practically all of the patients were married or had been sexually active. Most of them had had children. Nineteen cases, or approximately 15 per cent, had positive Wassermann reactions. Although accurate religious or racial data have not been collected, it is believed that in the entire group of 1,558 cases, 3 of the patients were Jewish women of whom 2 at least had lived with uncircumcised men.

## DURATION OF DISEASE

The figures given in this section are not the same as data based upon a series reported for therapy evaluation since our cases represent only deaths.

It is significant that in general the longest length of life, after discovery of the disease, occurred in patients who appeared for examination and treatment shortly after the onset of symptoms. The largest number of patients are found to have been under our observation and care for less than 3 months before death. Forty-one, or approximately 33 per cent, of the patients were with us for 1 month or less. Twenty-three

patients were under observation and treatment by us for from 1 to 2 years. The total duration of the disease from onset is relatively short. The average length of life is 16.7 months excluding one 0 year case. Twenty six lived 1 year 13 lived 2 years, 10 lived 3 years and 5 lived 4 years. The majority died within 18 months.

Twenty-one per cent of the patients appeared for treatment within 3 months of the onset of their symptoms. An almost equal number delayed medical consultation for 6 months. Thirty patients, or approximately 25 per cent did not seek advice for a year after they noted symptoms of some pelvic or vaginal disorder. These figures indicate delay as the chief reason for the high rapid mortality.

#### NATURE OF SYMPTOMS

The outstanding feature of clinical symptomatology in cervix cancer is vaginal bleeding. Continued or intermittent hemorrhage was noted by 108 patients or 88 per cent. Of these 4 patients described postcoital incidence. Eight per cent described purulent vaginal discharge as their outstanding symptom, which in almost all cases eventually became bloody. Discharge associated with recurrent bleeding incidents was noted in 11 cases or 9 per cent. Although pain is a primary major symptom was relatively infrequent abdominal pain was noted as an associated symptom in 7 per cent of the cases. These were usually patients harboring pelvic infection. Leg or thigh pain occurred in patients with pertheural lumbar plexus involvement by neoplasia, or as a result of direct neoplastic invasion of pelvic bones, similar to the lesions in late prostatic cancer.

#### SURGICAL INTERVENTIONS

Some patients had accidental discovery of disease incidental to their operations. In general surgical operative treatment was ineffectual in controlling the course of the neoplasm. There were 7 cases in which supracervical hysterectomy had been performed. It is not known which of these cases represent primary stump cancer following operation for myomas or which ones represent postoperative recurrent or residual disease after surgery performed as part of a combined therapeutic program for attempted cure.

We have encountered instances of attempted relief of the urological complication in late pelvic cancer of which 5 examples are included in this series. In view of the extent of disease necessary to produce lesions requiring such surgical relief as nephrectomy or ureterostomy we have concluded that such palliative surgery is contra-

indicated since it adds a further problem in the already complicated management and does not add to the patient a comfort or length of life.

#### CLINICAL STAGE UPON ADMISSION

Clinical classification of cervix cancer in our institution is in accordance with the League of Nations plan based upon the following criteria.

Stage I represents the early lesion with only cervix involvement. Stage II presents extension to vaginal epithelium with infiltration of one or more of the fornices. Stage III presents parametrial or pelvic invasion with uterine fixation. Stage IV describes the so called frozen pelvis with diffuse pelvic infiltration by a solid mass and obliteration of landmark structures or wide spread and distant metastases of other types. Stage II plus is a subsidiary classification in which fall those cases of early usually unilateral parametrial extension without uterine fixation.

Stage III in our series was noted in 49.2 per cent of patients upon admission and 30.4 per cent were already in stage IV. Almost 80 per cent of patients were therefore in a markedly advanced stage of the disease before their symptoms became severe enough to cause them to seek medical attention despite the fact that the local cervical condition was usually then noted to be well advanced. Various stages of necrotic ulceration and bulky tumefaction. Apparently the local disease process may be well under way and may have produced marked pelvic extension without subjective evidence or symptoms causing great discomfort or inconvenience. This again indicates the necessity for educational measures designed to emphasize the importance of personal hygiene and an appreciation of the significance of presumably unimportant vaginal bleeding or discharge.

Except in obviously terminal cases, it has been the practice to treat these patients with either high voltage radiation or radium or both. Considering the analysis of duration of disease it is manifestly hopeless and irrational to attempt curative therapy in advanced cases. Radiation however has been used as a satisfactory palliative measure for the control of hemorrhage. For this reason it has been used in most cases.

In our series only 2 cases were in stage I, 12 cases 9.7 per cent, were in stage II and 1 case, 0.8 per cent in stage II plus. Two cases showed no clinical evidence of disease on admission.

#### PATHOLOGICAL DISPOSITION AT ADMITTANCE

One hundred and twenty two cases were found to be squamous carcinoma and 11 cases showed

adenocarcinoma upon admission, either by biopsy or examination of slides prepared upon a previous admission at another institution. Not all specimens were graded, although in recent years the attempt was made to so classify the tumor sections. Most of these were grades II and III. It has been found, however, that the infection and necrosis present in most tissues from advanced cases make grading unreliable if not impossible. Despite a presumed relationship between the grade of the tumor, its radio sensitivity and its subsequent course, we have been unable to justify any evaluations of degree of relative malignancy on this basis in cervix carcinoma. Even fairly well advanced, clinically stage II, pathologically grades I, II, and III lesions will respond locally in a satisfactory manner to topical radium and in many instances superficially heal completely. The patient's death, however, is inevitable as a result of the disseminated disease which, when well advanced at the onset of treatment, cannot be controlled in its course through the retroperitoneal lymphatics and in its massive infiltration in the pelvis.

It may not be out of place to mention the necessity sometimes of multiple biopsies from different areas or at different times in order to make an accurate original diagnosis or to evaluate progress of therapy or recurrence. One examination of necrotic tissue from a crateriform ulcer, for example, may not be sufficient to establish a correct diagnosis. Biopsy must be repeated until all reasonable doubt of a negative report is dissipated.

#### OCCURRENCE OF FISTULAS

Although direct invasion of the bladder and rectum with fistula formation is not a necessary precursor of urinary and peritoneal sepsis, the unusually high incidence of fistulous complications in many instances speeds up the progress of the disease by directly introducing a serious uncontrollable situation. There were 37 cases in which vesicovaginal and vesicorectal fistulas were noted. Although only 4 were noted upon admission, the often rapid supervention of this complication and its demonstration at autopsy within a relatively short time indicates that the presence of these fistulas is more frequent than is clinically realized. The fact that 30 per cent of these patients harbored such abnormal communications has led us to speculate upon the reasons for their occurrence. The fistulas are not always simple single tracts between the bladder or rectum and vagina. Numerous instances of complicated multiple fistulas involving various combinations

of bladder, rectum, uterus, ureters, and vagina have been found.

One would expect to find that the usual cause for their occurrence is neoplastic invasion by direct continuity. Seven cases of the 37 were untreated by any means during the course of the disease. Two patients were initially treated only by operation, in 1 the fistulous complication was presumably the indirect result of operative trauma.

A discussion of the relative values of various forms of radiation therapy is not germane to the subject of this communication, and a detailed study of these aspects of the problem is reserved for a subsequent paper. Despite the fact, however, that the present material does not statistically completely substantiate all our impressions, we have always felt and still maintain that the rapid administration of high radium dosage intravaginally has a deleterious effect and predisposes to fistula formation to a greater degree than does the slow or French technique utilizing a smaller amount of radium over a longer period of time. Our figures show 5 cases of fistula in patients treated by rapid or "bomb" radium and 11 cases in patients treated by the slow method. Twelve cases treated by high voltage radiation alone without radium developed fistulas. Although these figures are paradoxical, it must be remembered that the rapid technique is used in only two institutions in New York and these cases form a relatively small proportion of the total.

#### ANTEMORTEM SYMPTOMATOLOGY

In contrast to the outstanding symptom of hemorrhage and discharge noted at onset, the chief symptom or state observed clinically during the month before death was sepsis. Seventy-one cases, 57.1 per cent, had evidence of profound toxemia, infection, and fever as the outstanding feature of the terminal course. Seven other patients manifested this state in sufficient degree to have it noted as an important secondary factor. Hemorrhage of severe character was seen in 17 cases, 13.2 per cent, with 5 more cases presenting this feature as an important concomitant symptom.

Many patients manifested no specific symptomatology other than weakness, stupor, anemia, and general debility. These have been grouped under the heading of cachexia, primary in 12 cases, 9.6 per cent, and secondary in 9, 7.3 per cent.

Cardiorenal failure was diagnosed in a total of 13 cases, 10.4 per cent, while intestinal and



abdominal symptoms predominated clinically in 6 cases, 4.8 per cent. Other symptoms, such as dysuria, rectal dysfunction, pulmonary infection, and diabetes accounted for the remainder.

#### ACTUAL CAUSE OF DEATH

It is a reflection upon the clinical acumen of the resident staff officers in their evaluation of the actual terminal situation of these patients at death to find that although the clinical diagnosis is generally accurate the true specific pathological cause of death was frequently overlooked, unappreciated, or at least unnoticed. There are several reasons for this, chief of which is the fact that these patients are usually in such bad state at death that it is difficult to determine all the facts accurately. Cardiac failure and pulmonary edema are common and pneumonia, which may clinically be an outstanding fatal symptom, is seen pathologically to be more often merely one of the terminal manifestations of a generalized septic process.

Table I summarizes the actual clinical and pathological findings in 124 cases. Attempt has been made to list both the primary or chief cause and the outstanding associated secondary conditions found.

In 92 cases, 74 per cent *sepsis* is the chief pathological diagnosis. A breakdown of this group shows that there are 4 main subdivisions (Table I).

*Local sepsis* (which includes *aglymphatic ulceration*, abscess, parametritis, infected ulcerated fistulas) was an associated finding in 75 cases, 60.6 per cent, but was found to be extensive enough to be listed as a primary cause in 7 cases, 13.2 per cent.

*Peritonitis* accounted for 8 deaths, 14.5 per cent, with 2 cases, 1.6 per cent, listed as a secondary state. This condition is seen to be a much more frequent and important terminal complication than hitherto believed and follows pyometra and pelvic abscess by direct extension through perforation of the uterus. Purulent infection with *bacera* formation in the uterus and adjacent pelvis was found in 20 cases. Interference with uterine drainage is the basic factor here.

There are two main causes for such occurrence. One group is usually seen following treatment in which the local cervix lesion may be controlled or even healed with the production of synechial adhesions in the vault of the vagina or closure of the cervical canal causing subsequent interference with uterine drainage. Pyometra supervenes and the lack of drainage *per vaginam* causes retrograde extension and perforation into the pelvis.

TABLE I.—ANALYSIS OF CAUSE OF DEATH IN 124 COMPLETE AUTOPSIED CASES

Primary cause is given in chief clinical diagnosis in more pathologic-pathological factor.  
Secondary causes listed represent associated significant findings.  
Figures show number of instances.

	Clinical diagnosis				Pathological diagnosis			
	Primary		Secondary		Primary		Secondary	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Sepsis	69	5		6	94		79	65
a. Local (vaginal, pelvic abscess, parametritis, etc.)					17		77	60.6
b. Peritonitis					15			
c. Cause of death (including embolism and blood stream infections)					16	12		
d. Myocarditis					20		1	
Hemorrhage and anemia	26	13			10			
Uremia— <i>see</i> Index			6		6	3		
Associated conditions seen in 92 cases of sepsis (see Index) and pyometra, etc.)							20	15
Pneumonia							25	20
1. Generalized infection (as sepsis, pyometra, etc.)							24	17
2. Cardiac failure and pulmonary edema	10	8		6		17		
3. Intestinal disease						8		
4. Tuberculosis			1					
5. Shock								
10. Cachexia							20	16
					Pyometra and pelvic abscess— <i>see</i> Index — <i>see</i> Index — <i>see</i> Index		17	

The second main group is composed of those cases in which drainage is blocked by bulky tumor. A not inconsiderable number of patients present themselves with huge masses of tumor tissue filling the vagina, arising from the cervix. This tissue is a veritable carbuncle of carcinoma, composed of sponge-like overgrowth of tumor tissue, its interstices filled with pus and blood. The vagina is filled and the cervical canal occluded. Pyometra, parametritis and pelvic abscess result. This is the one situation in which removal of the tumor tissue by surgical means is



Fig 1 Iliac artery showing invasion of perivascular lymphatics by carcinoma of cervix N Y C C I, Autopsy \LI/37

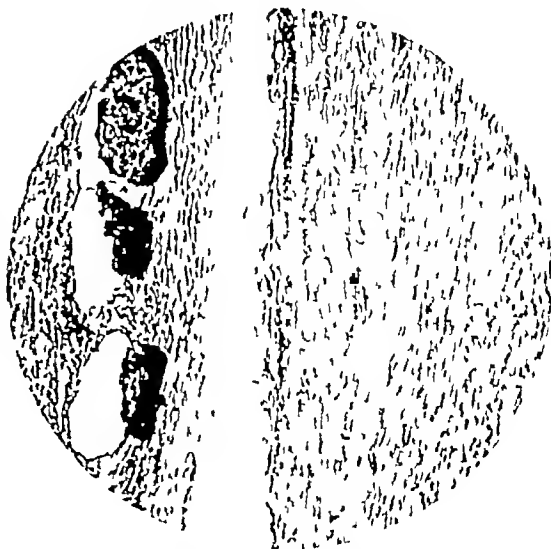


Fig 2 Iliac artery showing invasion of perivascular lymphatics by carcinoma of cervix N Y C C I, Autopsy \LI/37

justifiable and necessary before the administration of radium or x-ray therapy. The bulk of the tumor may be readily resected under direct vision by means of the endotherm cutting current, with hemostasis by means of coagulation of the base. The cervical canal can then usually be identified and uterine drainage effected by the introduction of a tube through which the intra-uterine abscess cavity may even be irrigated with hypochlorite solutions. Intra-uterine radium should not be introduced until the major infective process has subsided. We have 1 case in which death followed uterine perforation with peritonitis following radium introduction into an unrecognized pyometrial cavity. Occasionally radium applied to the cervix base intravaginally after resection of the bulk of the tumor as described will control the external lesion and make the cervical canal identifiable in cases in which this is previously impossible. Intra-uterine therapy may then be instituted.

Peritonitis is not only of the pelvic and low abdominal type but in about half the cases manifests itself as a diffuse, fibrinopurulent, plastic, exudative process. Unfortunately for accurate antemortem diagnosis, the peritoneal lesions are often clinically silent.

*General sepsis* is a term which includes endocarditis and blood stream infections, embolic abscesses of widespread distribution, typical splenic changes and other manifestations of

generalized infection. This diagnosis accounted for 28 deaths, 22.5 per cent, and is listed as a subdivision to include those cases in which the infective processes were not specifically related to a single system although, of course, marked local or renal pathology, for example, may have been concomitantly present.

The largest single subdivision in the septic group, however, is formed by the 31 cases, 25 per cent in which the major infective lesion was in the urinary tract.

*Nephrogenic sepsis* or *urogenic sepsis* is considered to be, for purposes of classification, that form of disease in which an overwhelming urinary tract infection is the major cause of death. In addition to this group, however, there is subgroup Table I, 3a, in which fall 89 cases, 71.9 per cent, in which associated damage to the urinary tract was present, in addition to some other specific major state. These figures are startling in that they indicate lesions of the urinary tract to be the most important single specific influence in the downhill path of patients dying of cervix cancer, for practically all of the patients in this study had some degree of urinary tract damage.

The pathogenesis of ureteral block and renal infection is seen as a result of two processes: one early and insidious, the second later and massive in its manifestations. In the earlier group it develops as a result of peri-ureteral lymphatic invasion by carcinoma cells traveling in the retro-

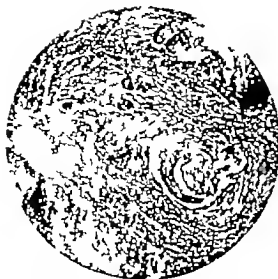


Fig. 3 Carcinoma of cervix—Invasion of pericervical lymphatics. N.Y.C.C.T. Autopsy CLXV/36



Fig. 4 Carcinoma of cervix—Invasion of pericervical lymphatics. N.Y.C.C.T. Autopsy CLXV/36

peritoneal channels. Circumferential infiltration, constriction of the ureter and ureteral mucous membrane damage are successive stages. The more obvious lesions, however, are the result of massive pelvic deposits with bladder and ureter infiltration and constriction. Interference with drainage and kidney function is a gradual process in which infection supervenes usually in an early period by the ascending route. Various degrees of cystitis, ureteritis, hydro-ureter and pyo-ureter, hydronephrosis and pyonephrosis, and pyelonephritis are seen. The tendency to renal failure without major infection is also manifest, although death by uremia is usually associated with some form of nephrogenic (or urogenic) sepsis, which in our classification takes precedence as a major specific cause of death. Although uremia (Table I, 3) alone is noted clinically in 4 cases (11.2 per cent) in only 6 cases did it prove to be the outstanding lesion, since it is almost always associated with the urinary sepsis states.

It has been found that blood chemistry figures except in terminal states, are not accurate index to renal function in our material. This may be due to technical difficulties or to complicating factors as a result of other associated conditions. We have found, however, that intravenous urography provides a consistent means for evaluation of the progress of the pelvic disease. For about 5 years attempt has been made to follow all except obviously terminal cases by roentgenography of the urinary tract after the intravenous injection

of excretory contrast media. In this way it has repeatedly been able to demonstrate gradual dilation of ureters and renal pelvis and eventual anuria or non-functioning kidneys. Cystoscopy and ureteral catheterization have occasionally aided in establishing drainage following dilation of the ureter in its constricted portion. Such therapy must be instituted early to be of value. We have not found, however, that extensive urological operations designed to exteriorize urinary drainage are satisfactory or helpful as far as the end-result is concerned.

It has occasionally been stated that ureteral block is the result of fibrosis following an extensive radiation program of radium and high voltage to the pelvis causing constriction of tissues about the distal end of the ureters. Our pathological studies have consistently demonstrated, however, that this is not so since all obstructive lesions of constricting or compressing character have been found to be the result of neoplastic invasion with or without accompanying desmoplastic fibrosis. Photomicrographic slides of material dissected from these regions demonstrate the nature of the changes which occur (Figs. 1, 3 and 4).

Even cases in which direct ascending infection is not manifest on account of complete block or closure of the distal ureter lumen it must be recalled that the high frequency of colon infection in these obstructed kidneys may result from bacterial invasion either directly from the bowel or



Fig 5 Carcinoma of cervix—superficial healing complete Deep down in the body of the cervix there was found a vessel containing carcinoma N Y C C I, Autopsy CXXXII/35

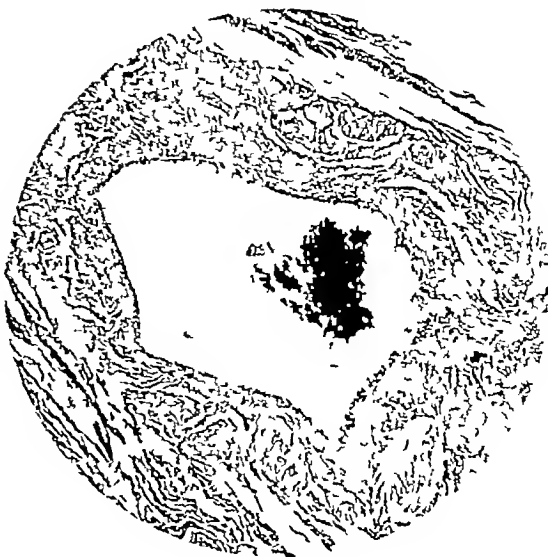


Fig 6 Carcinoma of cervix—superficial healing complete Deep down in the body of the cervix there was found a vessel containing carcinoma N Y C C I, Autopsy CXXXII/35

pelvic inflammatory lesions through the damaged wall or by way of retrograde lymphatic extension.

*Hemorrhage* and *anemia* account for 8 per cent of deaths on a primary pathological basis with an additional 7.3 per cent in which it was an important secondary factor. This comprises the second largest primary group pathologically, although from a clinical standpoint the combined primary and secondary diagnosis was made in 28 cases for a total of 22.6 per cent. This discrepancy in clinical and pathological findings indicates that although marked blood loss is an outstanding feature of the late course and even is frequently the precipitating fatal factor, it is more frequently considered to be an occurrence which results from the erosion of larger vessels in the course of a major ulcerative and septic process.

Although *pneumonia* was present in 38 cases, 30.7 per cent, as a secondary feature at autopsy, in only 6 cases, 4.8 per cent, was it considered to be the primary pathological diagnosis although death was clinically ascribed to it in 22 cases. In many of these cases a terminal lobular pneumonia is a concomitant part of a general sepsis or cardio-renal failure in patients weakened by long continued toxemia.

*Generalized metastases*, in which lesions were found beyond the pelvis and retroperitoneal nodes, were seen in an unusually high number of cases. In 34 instances, 27.4 per cent, metastatic dissemina-

tion was found in the liver, lungs, spleen, kidneys, bones, mediastinum, neck, brain. In 5 cases, 4 per cent, death was considered to be directly attributable to the effects of such distant dissemination. These were instances in which the lungs, pericardium, mediastinum, and heart were involved with the production of high vascular occlusion, hydrothorax and hemothorax and other associated lesions of the organs in the thoracic cage.

Cervix cancer has not commonly been considered as a source of widespread metastasis. Extensive thoracic and skeletal involvement occurred in our series in 8 cases. The most marked dissemination was seen in cases of long duration, this group including the  $1\frac{1}{2}$  to 10 year survivors. Apparently the reason that more instances of generalized metastases are not noted is because patients do not live long enough to have them. One patient, however, died with such dissemination in 8 months.

Involvement of the pelvic bones by direct invasion similar to the lesions in prostatic cancer was also noted.

The clinical diagnosis of *cardiac failure* and pulmonary edema was made in 18 cases, 14.4 per cent. Pathologically only 3 patients had their deaths attributed directly to this condition, whereas 27 patients, 21.8 per cent, were noted to have such associated pathology as a terminal



Eighty-eight per cent of patients reported vaginal bleeding as the outstanding symptom

Surgical operation, either for cure or palliation, was ineffectual in altering the course of the disease, except in the case of removal of bulky masses to establish uterine drainage

Eighty per cent of patients were in clinical stage III or IV upon admission to our institution. No form of therapy can arrest the disease in these stages

All except 2 patients had squamous carcinoma as shown by biopsy

Vaginal fistulas, sometimes of complicated type, were present in 30 per cent of the cases. While many are the direct result of neoplastic invasion, we feel that some have been hastened or caused by treatment

The chief antemortem symptoms or signs in these patients were manifestations of a septic state

The outstanding cause of death in cervix cancer was sepsis either directly from, or secondary to, a local pelvic lesion. Chief groupings of the pathological diagnoses at autopsy are as follows

- 1 Sepsis (a) local—ulceration, abscesses, pyometra, (b) peritonitis—usually by direct extension through uterine perforation, (c) general—including blood stream infections, (d) nephrogenic (or urogenic)—in which overwhelming infection arises in the urinary tract

- 2 Hemorrhage and anemia

- 3 Uremia—renal failure

- 4 Pneumonia

- 5 Generalized distant metastases—beyond the pelvis and retroperitoneal nodes

- 6 Cardiac failure and pulmonary edema

Intravenous urography is the best method of demonstration and evaluation of renal function and ureter block. Damage to the urinary system occurs in almost all cases

#### CONCLUSIONS

We believe that cancer of the cervix is amenable to successful treatment by radiation in various forms and combinations and the literature contains numerous authoritative and well substantiated reports of 5 year cures and over. Such results can be obtained only when adequate treat-

ment is given to patients in the early stage of their disease and then continuous follow-up observation and treatment maintained

To our best knowledge, there has been no previous attempt to evaluate accurately the causes of failure in the therapy and the real cause of death of the greater number of even presumably well treated patients

Curative therapy is useless in clinical stages III and IV cases. Even though the local visible vaginal lesion may be banished and its recurrences controlled, most cases eventually in necrosis with ulceration and severe local infection. The paramount difficulty in treatment is the control of the progressive damage to the urinary tract which is involved in almost all late cases. Superimposed infection results in an overwhelming majority of the cases and is the outstanding cause of death. Although infection of the urinary tract is the most important source of sepsis, peritonitis forms a large group which has not previously been sufficiently recognized since the process is frequently clinically silent

Metastases of widespread character are not uncommon and should be noted more and more often in the future as therapeutic measures become more widespread in their application, resulting in longer life for these patients who, untreated, usually die within 18 months. Bone metastases, both of hematogenous skeletal distribution and of direct contiguous pelvic type, will be noted as patients live long enough to develop them. Thoracic lesions are also to be noted

The most striking feature of this study, aside from the pathological findings, has been the realization that most patients come for treatment when they are already in an advanced stage and have had significant symptoms extending over from 6 to 12 months before seeking medical advice. With the remarkable progress that has been made in the techniques of therapy, the next step in the control of cervix cancer lies in the road of education—both lay and professional—to make both patients and physicians appreciate the possible significance of abnormal vaginal bleeding. Once the possibilities are appreciated perhaps they may be induced to do something about it

manifestation. *Intestinal ileus* due to intussusception accounted for 1 death. *Embolism* for another. Clinical diagnosis of shock in 1 case was found to be explained by peritonitis with perforation of the uterus following radium. Eight cases in which cachexia was indicated as a clinical diagnosis were all found to have other specific pathological conditions to account for their failure.

With very few exceptions almost all patients had varying degrees of pelvic infiltration. It is notable however that at death 57.45 per cent, showed such infiltration to be extensive enough to be classed as frozen pelvis in which a mixture of inflammatory and tumor tissue completely filled the pelvis with obliteration of normal spaces and landmarks. Many of these solid infiltrations were the seat of varying degrees of inflammatory change ranging from diffuse phlegmonous infiltration or cellulitis to large areas of necrosis with cavitation and varying forms of abscess formation. True pelvic abscess, however was usually in association with pyometra by extension. It is our impression that many of the major necrotic areas may have been produced as a result of heavy radiation delivered to bulky infected tumor tissue.

#### POSTMORTEM PATHOLOGY

In carcinoma of the cervix, probably more clearly than in any other type of cancer we see how and why unchecked cancer ultimately kills. Its pernicious spread is methodic, and, in the light of our experience of the anatomic table, predictable. No undiscovered toxin presumably secreted by the carcinoma cell and poisoning the system need be postulated. Carcinoma of the cervix kills because in its onward spread through anatomic routes it mechanically interferes with the physiological function of tissues and organs in its path. Treatment of the local condition is today hardly a problem for the therapist. Progress of the disease beyond the local area may well and too often does, defeat his best efforts.

Permeation of the lymphatic spaces in the connective tissue of which spaces the cervix has an abundance, is the chief method of advance. Perineural and perivascular lymph spaces are equally invaded. Invariably the periureteral lymph spaces are attacked, and if the patient does not die earlier for other reasons, she is bound to die from some effects of ureteral obstruction usually with infection of the urinary tract. Involvement of the bladder and the rectum occur but we have never been able to record either of these occurrences as the actual cause of death.

Periureteral invasion by carcinoma with con-

striction of the tube has been repeatedly found and demonstrated by us in both treated and untreated cases. In none of the treated cases have we had to attribute ureteral obstruction to fibrosis presumably brought about by the treatment. In our opinion, this is an over rated danger (Figs. 1 to 6).

Downward spread into the vagina and the less frequent but not rare upward advance into the corpus are also part of the advance by permeation of lymphatic spaces, but they have never proved to be death dealing complications except when pyometra has given rise to peritonitis.

In its spread to the pelvic tissues, carcinoma of the cervix does not spare the bones, if the patient lives long enough. Though blood borne metastases to bones occur we feel that the most frequent bones involved (i.e. involvement of the pelvic bones) occurs not by the blood stream but again by direct and lymphatic extension. A paper by Barany and Saha soon to be published, deals with this specific problem.

Spread through lymphatic vessel with involvement of the lymph nodes occurs as rule in cases in which the tempo of the growth has been retarded. We have seen in some cases of spread by lymphatic vessels a remarkable adherence to the course charted by the anatomy where we have been able to demonstrate orderly progress of invasion of the nodes at the base of the broad ligament, and then the iliac, hypogastric, and sacral nodes, followed by the retroperitoneal mediastinal, supraclavicular and even cervical nodes. Cases have been found, however in which the nearest nodes have been spared and metastases have been set up in more distant nodes, probably by tumor embolism.

Blood-borne metastases are nowadays not rare. We believe that they occur very late and their more frequent occurrence is to be explained only by the fact that more patients are enabled to live long enough to get them.

#### SUMMARY

One hundred and twenty four autopsied cases of cervix cancer have been analyzed.

There is a relatively higher incidence of this disease in colored women.

The greatest incidence is seen in the fifth decade. The average length of life of these patients was less than 17 months from onset as near as could be determined. The majority of patients died within 8 months. Half the patients seen had symptoms for 6 months and another quarter of the total number did not seek medical advice for a year.

TABLE I—PRIMARY PARTIAL GASTRECTOMY FOR DUODENAL ULCER\*

TABLE I—PRIMARY PARTIAL GASTRECTOMY FOR PEPTIC ULCERS ET AL						Follow up						
Pre-operative status	Operative technique	Total cases	Operative mortality			Cases	Condition					
			Cases	Per cent	Causes of death		Good		Nausea, etc. p o no symptoms of ulcer		Recurrent symptoms of ulcer	
							Num ber	Per cent	Num ber	Per cent	Num ber	Per cent
	Posterior Pólya	144	3	2 1	1—Pulmonary embolism 1—Myocardial infarction 1—Bronchopneumonia peritonitis?	134	100***	81 3	21	15 5	4†	3
Duodenal ulcer without previous ulceration	Posterior Pólya	25	0	0		25	21	84 0	3	12 0	1	4 0
Duodenal ulcer with previous closure of perforation	Posterior Pólya	43	1	2 3	1—Pneumonia, peritonitis, and duodenal fistula	38	35	92 0	3	8 0	0	0
Gastric and duodenal ulcers concurrently without previous operation	Total posterior Pólya operations	212	4	1 9		197	165***	83 5	27	14 0	5	2 5

\*More than one third of stomach removed

\*\*Includes 4 anterior Pólya Balfour operations

†Two died at home but without symptoms of ulcer

+Three had gastrojejunal ulcer by roentgenologic examination 1 had a recent hemorrhage.

In the reports previously referred to, the follow-up studies have been as follows. Lahey and Marshall observed excellent results in 84 per cent of cases, fair results in 9 per cent, and recurrence in 7 per cent. St. John and his associates noted good results in 90 per cent of cases, Finsterer observed cures in 94 per cent of 236 cases, improvement in 34 per cent of cases, and no cure in 21 per cent of cases. Still obtained good results in 90 per cent of cases after performing the Finsterer type of resection. Lake, in a series of 198 cases, found such treatment unsatisfactory in 15 cases, or 7.6 per cent, 3 cases of anastomotic jejunal ulcer occurred, less than 2 per cent. Berg, in a series of 516 cases in which primary and secondary operations were performed, found recurrence in 11 per cent of cases. Crile and Crile found, in a follow-up study of 20 cases, that gastric symptoms occurred after operation in 20 per cent.

Ogilvie found no recurrence after 100 partial gastrectomies in which the pylorus was removed, but 3 recurrences were encountered in 12 cases in which operation was performed for duodenal ulcer and in which the pylorus was not removed. This is in contrast to Finsterer's experience with 236 cases in which he observed cure in 94 per cent and recurrence in 21 per cent. As a rule, removal of the pylorus was not carried out by Finsterer (1926).

In none of these reports is a clear distinction made between the results of primary partial gastrectomy for duodenal ulcer on the one hand and the results of partial gastrectomy for gastric ulcer and for anastomotic jejunal ulcer, on the other.

The present study includes 187 patients on whom primary partial gastrectomy of the Pólya type was performed for duodenal ulcer, during the period from January 1, 1929, to January 1, 1939, but 43 of these patients with duodenal ulcer had associated gastric ulcer (Table I). In most of these cases, operation has been performed in the past 6 years. It also includes 25 patients who had recurring duodenal ulcer following previous closure of acute perforations, on whom partial gastrectomy was performed at the clinic in this same period of time. For clarity, those patients who have not had a previous surgical procedure performed on the stomach or duodenum are separated from those who have previously required surgical closure of a perforated duodenal ulcer. In some cases of the latter group, a form of pyloroplasty may have been performed when the perforated ulcer was closed.

In addition, those patients who at the time of operation at the clinic, were found to have a gastric ulcer as well as a duodenal ulcer are separated from those patients who had only a duodenal ulcer. No patient was included in the



# PRIMARY PARTIAL GASTRECTOMY (POLYA TYPE) FOR DUODENAL ULCER

## A Study of Results in 212 Cases

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ALTHOUGH partial gastrectomy for duodenal ulcer that is resistant to medical treatment has been almost a routine procedure in parts of Central Europe for many years, only in the past 9 or 10 years has this method of surgical management of duodenal ulcer assumed an important status in North America. It is desirable, therefore, to review the results of partial gastrectomy of the Pólya type performed at the Mayo Clinic for duodenal ulcer. Partial gastrectomy of the Billroth I type is not included in this review as this procedure is less commonly used and in the experience of one of us (Walters) it has not been so effective in the treatment of duodenal ulcer as has the Pólya operation. However, the results of a series of cases in which the Billroth I type of gastric resection was performed will be presented at a later time. Patients who had a gastroenterostomy or partial gastrectomy performed at previous time were not included in this series.

The indications for partial gastrectomy for duodenal ulcer are difficult to define. This is due to the fact that there are some surgeons who believe that partial gastrectomy should be done as a routine procedure for all patients who have duodenal ulcers that require surgical procedures. Such a viewpoint explains the higher mortality of partial gastrectomy than when an operation is chosen on the basis of the patient's general condition and the character of the duodenal ulcer both as regards size, extent, and situation. We have

attempted to evaluate results of partial gastrectomy performed for duodenal ulcer in a group of cases in which the condition of the patient, the size of the duodenal ulcer, and the mobility of the duodenum would indicate that partial gastrectomy, removing, in most cases, more than half of the stomach including the pyloric sphincter muscle, the first portion of the duodenum and the duodenal ulcer could be accomplished with sufficient duodenum remaining to be accurately

closed, thus assuring that the operation might be done with reasonable safety, leakage from the duodenal stump is the operative menace.

The patients for whom we have thought the operation of partial gastrectomy for duodenal ulcer might be indicated were those in the third, fourth, and the fifth decades of life, those who lead an active life, particularly from the occupational standpoint, those who because of lack of will power or desire on the patient's part, had not been following dietary restrictions prior to operation, those who would not give up the habit of smoking and drinking alcoholic beverages, and those who had experienced hemorrhages from the ulcer. Consecutive partial gastrectomies in 212 cases form the basis of our investigation. As an evaluation of the results of any particular method of surgical procedure, it is important to make a comparison of the mortality and results as well as the applicability of the procedure as compared with other surgical procedures.

A high mortality rate associated with partial gastrectomy is the basis for most of the criticism of the method. An operative mortality as high as

8 per cent has been reported from two clinics (5). However, these series included secondary operations which carry a higher risk than primary procedures. Lower figures for operative mortality have been presented by Finsterer (1 per cent in 357 cases, 1926). Still (4 to 5 per cent in 84 cases, 3 of which were of duodenal ulcer). Graham (3.8 per cent in 40 cases). Berg (6.9 per cent in 401 cases) and Lake (7 per cent in 24 cases). Most of the operations in these series likewise were performed for gastric ulcer and for anastomotic jejunal ulcer. Therefore, such figures do not accurately represent the operative risk of primary partial gastrectomy for duodenal ulcer.

Advocates of partial gastrectomy for duodenal ulcer have called attention to the low incidence of anastomotic jejunal ulceration and to the high percentage of good results that follows such procedure. In this regard also, there has been some variation in the experience of different

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TABLE I—PRIMARY PARTIAL GASTRECTOMY FOR DUODENAL ULCER\*

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Pre-operative status	Operative technique	Total cases	Operative mortality			Cases	Follow up						
							Condition						
			Cases	Per cent	Causes of death		Good		Nausea, etc. p o no symptoms of ulcer		Recurrent symptoms of ulcer		
							Num ber	Per cent	Num ber	Per cent	Num ber	Per cent	
Duodenal ulcer without previous ulceration	Posterior Pólya	144	3	2.1	1—Pulmonary embolism 1—Myocardial infarction 1—Bronchopneumonia peritonitis?	134	100**†	81.3	21	15.5	4†	3	
Duodenal ulcer with previous closure of perforation	Posterior Pólya	25	0	0		25	21	84.0	3	12.0	1	4.0	
Gastric and duodenal ulcers concurrently without previous operation	Posterior Pólya	43	1	2.3	1—Pneumonia peritonitis and duodenal fistula	38	35	92.0	3	8.0	0	0	
	Total posterior Pólya operations	212	4	1.9		197	165**†	83.5	27	14.0	5	2.5	

\*More than one-third of stomach removed

\*\*Includes 4 anterior Pólya Balfour operations

†Two died at home, but without symptoms of ulcer

+Three had gastrojejunal ulcer by roentgenologic examination 1 had a recent hemorrhage

clinics In the reports previously referred to, the follow-up studies have been as follows Lahey and Marshall observed excellent results in 84 per cent of cases, fair results in 9 per cent, and recurrence in 7 per cent, St John and his associates noted good results in 90 per cent of cases, Finsterer observed cures in 94 per cent of 236 cases, improvement in 3.4 per cent of cases, and no cure in 2.1 per cent of cases, Still obtained good results in 90 per cent of cases after performing the Finsterer type of resection, Lake, in a series of 198 cases, found such treatment unsatisfactory in 15 cases, or 7.6 per cent, 3 cases of anastomotic jejunal ulcer occurred, less than 2 per cent, Berg, in a series of 516 cases in which primary and secondary operations were performed, found recurrence in 1.1 per cent of cases, Crile and Crile found, in a follow-up study of 20 cases, that gastric symptoms occurred after operation in 20 per cent.

Ogilvie found no recurrence after 100 partial gastrectomies in which the pylorus was removed, but 3 recurrences were encountered in 12 cases in which operation was performed for duodenal ulcer and in which the pylorus was not removed. This is in contrast to Finsterer's experience with 236 cases in which he observed cure in 94 per cent and recurrence in 2.1 per cent. As a rule, removal of the pylorus was not carried out by Finsterer (1926).

In none of these reports is a clear distinction made between the results of primary partial gastrectomy for duodenal ulcer on the one hand and the results of partial gastrectomy for gastric ulcer and for anastomotic jejunal ulcer, on the other.

The present study includes 187 patients on whom primary partial gastrectomy of the Pólya type was performed for duodenal ulcer, during the period from January 1, 1929, to January 1, 1939, but 43 of these patients with duodenal ulcer had associated gastric ulcer (Table I). In most of these cases, operation has been performed in the past 6 years. It also includes 25 patients who had recurring duodenal ulcer following previous closure of acute perforations, on whom partial gastrectomy was performed at the clinic in this same period of time. For clarity, those patients who have not had a previous surgical procedure performed on the stomach or duodenum are separated from those who have previously required surgical closure of a perforated duodenal ulcer. In some cases of the latter group, a form of pyloroplasty may have been performed when the perforated ulcer was closed.

In addition, those patients who at the time of operation at the clinic, were found to have a gastric ulcer as well as a duodenal ulcer are separated from those patients who had only a duodenal ulcer. No patient was included in this

TABLE II.—SUMMARY OF RESULTS OF GASTRIC ANALYSES MADE AFTER OPERATION IN 116 CASES

Pre-operative status	Operative technique	Free acid	Follow up							
			Course		Condition					
			Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Duodenal ulcer without previous operation	Posterior Pólya	Present	16	100	16	100				100
		Absent	20	71	23	55		25		
Duodenal ulcer with previous closure of perforation	Posterior Pólya	Present	20				N. analysis			100
		Absent	30	11	36		Ko. analysis			
Gastric and duodenal ulcers concurrently without previous operation	Posterior Pólya	Present			45				No cases	
		Absent		100	69		100		No cases	

study unless a third of the stomach or more, was removed. Although at least one third of the stomach was removed in some of the earlier cases operated on several years ago by far the largest number of patients have been operated on in the past 5 or 6 years and in these instances we have removed half and usually two-thirds of the stomach.

Recent clinical information has been obtained from 197 (95 per cent) of the 208 patients dismissed from the clinic. Information also is available in regard to results of gastric analyses made after operation in 116 (56 per cent) of the 208 cases (Table II). Except for those patients who reply that they are perfectly well, it is difficult in many instances to classify the state of health of the individual. It is obvious that a person who has many so called functional symptoms, for which an adequate organic cause was not found before operation, may not be relieved of these symptoms by partial gastrectomy. Hence, the patient may not feel perfectly well after operation and yet he may have relief from the symptoms of duodenal ulcer and may represent a good result of surgical therapy.

This group of patients merges with another group in which there is no evidence of recurrence of the duodenal ulcer or of development of an anastomotic ulcer and yet the patients are not entirely well. Fullness after meals, and nausea, especially after breakfast, are the most outstanding complaints. Other less frequent, but equally annoying symptoms are sweating, especially after meals, fatigue and lack of strength. These symptoms have been attributed to irritability of the vagus nerve and too rapid emptying of the gastric contents into jejunum that is not prepared to receive such unmodified gastric contents. However these symptoms also may occasionally

follow performance of partial gastrectomy when the von Haberer modification of the Billroth I technique is used, after which the duodenum and not the jejunum receives the gastric contents. Most patients are able to obtain relief from these digestive symptoms by taking some care in regard to their dietary regimen and by lying down for a few minutes after eating.

It is interesting to observe in Table I that the best results occur among those patients who had gastric ulcer associated with a duodenal ulcer.

In our series, partial gastrectomy of the Pólya type among patients who had had an acute perforation closed at a former operation was followed by about the same percentages of good results and failures, as was partial gastrectomy of the same type among patients who had not had former surgical procedures performed on the stomach or duodenum. In this small group of 25 patients there were no postoperative deaths. Four deaths an operative mortality of 16 per cent, among the 25 patients who had primary partial gastrectomy is worthy of note. Two of the 4 deaths occurred following vascular accidents that at present, are largely unpreventable. One patient died of peritonitis associated with a duodenal fistula and one patient died of bronchopneumonia, with some resolving peritonitis present at the time of death.

In regard to the posterior Pólya type of partial gastrectomy performed as primary surgical procedure in the treatment of duodenal ulcer only it is apparent that 97 per cent of 134 patients whose course was followed after the operation did not experience the development of another ulcer. The 134 cases do not include the 25 cases of partial gastrectomy in which closure of an acute perforation of the duodenal ulcer had been performed previously and the 43 cases of duo-

denal ulcer in which there was an associated gastric ulcer. Eighty-one per cent of the 134 patients were able to live a normal life without undue restriction of their diet and activities. Some restrictions of diet and activity were required by about 16 per cent of the 134 patients in order to remain reasonably well. In 4 cases, or 3 per cent, evidence of ulcer developed. In 3 of these 4, a gastrojejunal ulcer was demonstrated by roentgenological methods. The fourth patient has been periodically incapacitated by hemorrhages. All of these 4 have obtained some relief from a medical regimen.

#### SUMMARY

In the 212 cases in which the posterior Pólya type of operation was performed, the mortality was 1.9 per cent. Although this was a consecutive series of partial gastrectomies, it is not to be assumed that it was a consecutive series of patients operated on for duodenal ulcer, for in many cases the large size or the character of the ulcer or the condition of the patient seemingly would not permit a partial gastrectomy without excessive risk, therefore, gastro-enterostomy, gastroduodenostomy, or pyloroplasty was performed.

Anastomotic jejunal ulceration occurred in 2.5 per cent of the total of 197 cases followed after partial gastrectomy. After the operation, 83.5 per cent of patients were well without undue restriction of diet or activity. Fourteen per cent required restriction of diet or activity or both in

order to remain in comparatively good health. Thus, a total of 97.5 per cent were without recurrence of ulceration after partial gastrectomy.

Of those patients on whom gastric analyses were obtained after operation, two-thirds to four-fifths of those without recurrent ulceration after operation had an acidity, and only rarely was a normal or greater than normal value for free acid obtained. When a jejunal ulcer was demonstrated, almost invariably greater than normal amounts of free acid were present.

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# EDITORIALS

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## SURGERY

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AUGUST 1940

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## CORONARY DISEASE AND SURGICAL THERAPY

THE article by Dr. Fauteux in this number of SURGERY GYNECOLOGY AND OBSTETRICS is evidence of the steadily increasing rôle of surgery in the treatment of disorders of the heart. The treatment of wounds of the heart, of suppurative pericarditis, and of chronic adhesive pericarditis by surgical methods is firmly established and is generally accepted. Surgical attack upon the sympathetic nervous system in angina pectoris has already won its way as a useful method in a limited group of patients. The application of total thyroidectomy for heart failure is still in the experimental stage and a final opinion as to its eventual place cannot be ventured. Ligation and division of a patent ductus arteriosus, as recently demonstrated by Gross, is a noteworthy contribution in the field of cardiac surgery.

In the last five years through the work of Beck, of Cleveland, and O'Shaughnessy, of London a new attack upon coronary disease

has been brought forward. These men have sought methods to improve an impoverished coronary supply by bringing blood to the myocardium through the establishment of an additional collateral circulation. They have demonstrated in animals that muscle grafts from the thoracic cage or fat grafts of a slip of omentum brought through the diaphragm may be laid on the heart; there may acquire firm adhesions and through these adhesions may revitalize a poorly nourished myocardium. This effort has continued with human cases, and, in a few instances, there seems adequate proof that these procedures have been beneficial. Whether such procedures can be generally applied without great risk and how great a benefit can be expected is yet to be ascertained.

Now Dr. Fauteux brings forward a new contribution in the same field. Pointing to the advantages in peripheral surgery of ligation of the major vein whenever the major artery is damaged or must be sacrificed, he has carried this principle to the surgical treatment of coronary disease. Finding first a point on the ramus descendens of the left coronary artery of a dog at which resection was universally fatal he demonstrated that the animal is saved if the companion vein is ligated at the same point simultaneously with the arterial resection. Moreover his experiments show that ligation of the vein at this point protects the animal against ligation and resection of the artery even when this latter procedure is carried out months later. He further discusses the similarity between coronary disease and femoral obliterative arterial disease and draws the conclusion that if resection of an obliterated femoral vessel and ligation of its

companion vein is good for the lower extremity, a similar procedure may be beneficial in coronary disease. He points out that the physical, as well as neuropsychological, interpretations of such a procedure are generally accepted in the field of peripheral vascular disease.

This is not the first time that such analogies have proved valuable, and certainly his experimental work justifies further endeavor along this line. As Sir James MacKenzie has said, the ingenuity of the surgeon may eventually overcome all obstacles in cardiac surgery, and certainly this contribution of Dr. Fauteux's is a challenge to all interested in the relief of a very common malady to man.

ELLIOTT C. CUTLER

## "FUNCTIONING" TUMORS OF THE OVARY

THE rather recent recognition of "functioning" tumors of the ovary with their characteristic trains of symptoms has furnished a chapter of lasting interest to the subject of gynecology. As a result of this knowledge new sign-posts have appeared in the diagnosis of certain gynecologic lesions and the treatment and prognosis of solid ovarian neoplasms have been improved materially. Even in the field of embryology these tumors have been revealing, too, for their structure has suggested why the ovary participates in the propagation of such a variety of neoplastic lesions.

From the primitive cells of the undifferentiated gonad there arises, through a process of cellular segregation or maldevelopment, the dysgerminoma. This tumor usually manifests itself in young individuals—more than 60 per cent of whom are more or less of a neutral or pseudohermaphroditic type. Amenorrhea or scanty menses are common symptoms,

the external and internal genitalia usually are developed poorly, and the breasts are frequently small. All of these features reflect a general lack of sexual differentiation. When the tumors are examined pathologically, they frequently are found to be bilateral, they are almost always encapsulated, and of brain-like consistency. Cytologically they are composed of highly undifferentiated cells resembling those found in the gonads before the stage of sexual determination. To the pathologist these tumors are of unusual interest because they occur in both sexes and are identical with the seminomas of the testis. To the surgeon they represent the paradox of a highly malignant neoplasm which carries a good prognosis, sometimes even after local extirpation. To the roentgenologist they represent one of the most radiosensitive lesions known.

The ovary of every woman carries within its hilus a potential testis. Just what combination of factors decides the fate of this potentiality is a matter of conjecture, but certain it is that occasionally these rests develop into arrhenoblastomas—testicular tumors in otherwise healthy ovaries. Depending on the number of interstitial cells present, and consequently the amount of testosterone elaborated, this tumor gives rise to masculinization with sterility, a syndrome which is so well known that repetition is scarcely merited. Although lesions other than those of the ovary more often produce this syndrome, its presence in a young or middle-aged woman who harbors a solid ovarian neoplasm should be sufficient to warrant an abdominal exploration with the probability of arrhenoblastoma in mind. These tumors command the respect of the surgeon because of the rather startling clinical improvement following removal. Menses return, usually within a month, the normal female habitus is soon restored, pregnancy becomes possible. Occasional recurrences are

noted and with them symptoms of masculinity return. However experience is accumulating which indicates that these tumors are usually of a low grade of malignancy. In most instances conservative surgery is justified especially when encapsulated arrhenoblastomas are encountered during the reproductive period.

Probably of much greater clinical importance is the granulosa-cell neoplasm which accounts for more than a tenth of all solid tumors of the ovary. It springs from a sexually differentiated cell, the granulosa cell and in contrast to the arrhenoblastoma, accentuates the state of femininity. This accentuation is best noticed among young individuals, for the tumor through its hormone, estrogen, gives rise to precocious menstruation, hypertrophy of the breasts, growth of pubic and axillary hair and early union of the bony epiphyses. More than half of these tumors, however, are seen among women past the menopause. Here recurrent periodic bleeding especially in the presence of an enlarged uterus should suggest to the keen clinician the possibility of a granulosa-cell tumor. Between the two extremes of life amenorrhea without masculinization or amenorrhea followed by metrorrhagia are fairly constant symptoms. Both reflect a high fluctuating level of circulating estrogen—the product of the functioning tumor cells. These tumors have certain definite gross and microscopic features which may be recognized by the alert surgical pathologist in fresh frozen sections and in collaboration with the surgeon he can safely advise conservative management in certain cases. Prompt improvement of symptoms almost invariably follows operation. Young individuals have not infrequently become pregnant after local surgical removal of granulosa-cell tumors. Extreme radiosensitivity is

also an important characteristic of these neoplasms.

Closely related to the granulosa-cell tumor on the one hand and the fibroma on the other are the theca-cell tumors of Loeffler and Priesel. Springing as they do from theca cells it is not surprising that many of these tumors elaborate estrogen and produce a syndrome indistinguishable from that of granulosa-cell neoplasm. Theca-cell tumors usually manifest themselves following the menopause and are somewhat more malignant than the tumors described in the foregoing. Fortunately they may be easily recognized at operation by their dense consistency and yellow color. Conservatism in the treatment of this group is not so important because of the age of the patient and the possibility of recurrence of the neoplasm.

Functioning tumors of other endocrine organs have long been known to the surgical profession, and it is thus not surprising that functioning tumors of the ovary have been discovered at last. Such tumors of this organ are of importance to the embryologist in that they represent various phases of cellular differentiation and specialization. To the endocrinologist they furnish concrete evidence of hormonal production and its clinical effects. To the internist they present possibilities in the identification of tumors that formerly went unrecognized. Finally to the surgeon and the pathologist there remains the interesting problem of confirming the clinical diagnosis and deciding on the proper line of treatment. The prognosis to the patient is far removed from that given in the days when these tumors were classed as atypical solid carcinoma and sarcomas of the ovary.

MALCOLM B. DOCKERTY  
VIRGIN S. COUNTELLER





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VIRGIL S. COUNSELLER.





EMMET RIXFORD  
1865-1938







His activity as an operator bridged the period between antiseptic and aseptic surgery between drainage and non-drainage of wounds, but his facile mind quickly accepted and improved upon the rapidly advancing developments in surgery. His own words vividly describe this period.

"It is interesting to have lived through the period of the greatest and most rapid development in operative surgery the world has ever known, for it is not overstating the case when one claims that in the last fifteen years of the 19th century and the first fifteen of the 20th, greater progress was made in operative surgery than in all the centuries preceding, the direct result, of course, of the earlier discovery and promulgation of general, local, and regional anesthesia, and the gradual percolation and application of the principles of antiseptics of Lister and of asepsis of Maclewen. I say gradual percolation of these principles, for it is difficult for the older generation to grasp the ideas and carry out the necessary practical details. For example, very much up-to-date surgeon, enthusiastic about antiseptics, could conscientiously almost scrub the skin off his hands and soak them in bichloride and then, just before making his incision, would scratch his ear or blow his nose, adjust his spectacles or wipe his moustache and forget to sterilize his hands. I saw another surgeon bit off the end of a silk thread as would any seamstress to facilitate threading the needle and one of our most noted local surgeons would hold his knife in his mouth when using other instruments in an operation. Practically speaking then the world had to wait for a new generation of surgeons to grow up before an aseptic technic could become automatic on a large scale.

Courageous in the face of technical difficulties that would defy the less experienced, he not infrequently scored a surgical triumph that astonished his associates. He early insisted upon a bacteriological and pathological study of his operative specimens, and was himself an excellent surgical pathologist. He was one of the first on this coast to employ the x ray and with it to locate accurately because of his engineering training, a foreign body in the brain, permitting its successful removal by his associate Dr. Stanley Stillman.

His engineering training made him particularly adept also in the understanding of fractures and dislocations, and a number of his papers dealt in original manner with the mechanics of the production and treatment of the greenstick, buckling, torsion and flexion fractures. His first paper in 1894 dealt with the symptoms and diagnosis of tuberculous disease of the joints. Subsequent papers covered the gamut of general surgery: the treatment of hernia, of goiter, of pancreatitis, of renal calculus, of gall stones, and of cancer in many sites; the rôle of industrial trauma in the development of cancer; the early history of the Pacific Coast medical schools and journals; the biographies of Cooper, Lane and Huntington; pioneer master surgeons of California.

Quick to recognize in one of his early patients from the San Joaquin Valley that he was dealing with an unusual infection, he sent material to Professors Welch and Gilchrist of Johns Hopkins for further intensive study which led subsequently to the recognition and description (by Rixford and Gilchrist in the first volume of the *Johns Hopkins Hospital Reports* 1896) of a new disease: coccidiodal granuloma, also known as the San Joaquin Valley disease.

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

IN the preface to the first edition of his book,<sup>1</sup> Magnuson states that it was written to meet the needs of the man who first sees the fracture. In the preface to the third edition, he reiterates this statement and emphasizes his purpose of calling attention to fundamental principles in diagnosis and treatment. Dr Magnuson succeeds to a remarkable degree in accomplishing just what he intended to do.

The first 4 chapters discuss the fundamentals of diagnosis and treatment, the pathology and repair of fractures, the mechanism of reduction and maintenance of reduction, and fixation apparatus, both splints and plaster dressings. These preliminary chapters contain much helpful information and sound general principles of fundamental importance in fracture treatment.

The 21 following chapters discuss individual fractures in all regions of the body. As each region is taken up, the consideration of the individual fractures is preceded by brief but adequate remarks on the anatomy of the part and the manner in which muscle pull affects the displacement of the fragments. If joints are involved, joint movements are described and the effect which the various fractures have upon joint function is brought out. Each type of fracture is adequately discussed, usually in considerable detail. The subject matter throughout is sound, logical, and thoroughly conservative in viewpoint.

Complete as this book is, there are certain omissions which should be mentioned and some statements which will not find universal acceptance. In the description of plates for use in the internal fixation of fractures, no mention is made of vitallium, a metal which is being used very widely and with considerable satisfaction. In the description of fractures of the acetabulum, no mention is made of dislocation of the hip joint with fracture of the posterior superior rim of the acetabulum, a very common fracture today as a result of automobile accidents. In the description of treatment of central dislocation of the head of the femur, no mention is made of lateral traction by a Kirschner wire passed through the trochanter, combined with longitudinal traction, this is a very valuable form of treatment. In the description of the treatment of fractures of the shaft of the femur, no mention is made of the use of internal fixation, yet this is being very widely used today. Fractures of this lower articular surface of the tibia, sometimes called posterior marginal fracture, comprising about 19 per cent of all ankle fractures, are very inadequately discussed, in view of the fact that this is a very difficult fracture to

reduce and maintain and results in marked disability if not adequately reduced. The statement that Volkmann's ischemic contracture is the result of tight splinting is today not generally accepted, as hemorrhage within the deep fascia is considered to be the most frequent cause of the condition.

The 2 final chapters deal with physical therapy and exercise in the treatment of fractures. This very much neglected part of fracture treatment is excellently and concisely covered and these chapters are full of helpful information and suggestions.

The general setup of the book is very pleasing. It reads easily, the type is large, and the illustrations are excellent and really explanatory. (It should be noted that Figure 217 is placed upside down.) The bibliography is very complete.

Dr Magnuson, relying upon his broad experience and his extensive material, has succeeded in writing a book which attacks the problem of fractures and fracture treatment in a very direct and enlightening way. It is an excellent treatise which can be highly recommended not only to those who treat fractures occasionally but also to those who make fracture treatment an important part of their practice.

FRANK D. DICKSON

IN its first edition *The Physiological Basis of Medical Practice* by Best and Taylor<sup>2</sup> rapidly became one of the foremost textbooks of physiology and has been widely used both by medical students and as a reference book. The second edition contains several revisions and the addition of a section on special sense physiology. In the preface the authors state that in the first edition they had not considered special sense physiology as being essential but that they had been prevailed upon to include it in the second edition. It is certainly a worth while addition and makes the book complete. Like the first edition it is written in a style which is easy to read and understand, and each section is generously illustrated. With the recent additions it should continue to be one of the outstanding texts in the field.

J. ROBCOL MILLER

THE text by Vinson<sup>3</sup> on diseases of the esophagus and their treatment is entirely new in its field. To the reviewer's knowledge it is the first attempt to present the subject in monographic style.

<sup>1</sup>THE PHYSIOLOGICAL BASIS OF MEDICAL PRACTICE. By Charles Herbert Best, M.A., M.D., D.Sc., F.R.S., F.R.C.P., and Norman Burke Taylor, M.D., F.R.S., F.R.C.S., F.R.C.P., M.R.C.S., L.R.C.P. 2d ed. Baltimore: The Williams & Wilkins Co. 1930.

<sup>2</sup>THE DIAGNOSIS AND TREATMENT OF DISEASES OF THE ESOPHAGUS. By Porter P. Vinson, B.S., M.A., M.D., D.Sc., F.A.C.P. Springfield, Ill. and Baltimore, Md.: Charles C. Thomas, 1940.

<sup>3</sup>FRACTURES. By Paul B. Magnuson, M.D., F.A.C.S. 3d rev. enl. ed. Philadelphia, Montreal, London: J. B. Lippincott Co. 1939.



which all present stocks are descended and was engaged in growing specimens for distribution to parks and horticultural societies. As skipper on the Sloop "Annie" brought around the Horn in the seventies, he won numerous races on San Francisco Bay and was at one time designated Commodore of the Fleet. When Annie's day was finally done she was reverently burnt at sea. As a young man he sang well and was a faithful member of St. Paul's choir. When the earthquake and fire of 1906 rendered many homeless, he was made chairman of a relief fund to help destitute physicians. Among the few things saved from his own burning home in that devastating fire were some armfuls of books which he buried in the yard. The Pacific Union, Bohemian, and Commonwealth Clubs of San Francisco claimed him as a member.

He is survived by his wife Mrs. Louise Campbell Rixford, two sisters, Mrs. Geneva Rixford Sargeant, an artist, and Mrs. Caroline Byrd, a brother Loring Pickering Rixford, a daughter Mary Campbell, and three sons, Loring, Dr. Henry Covington Rixford, a surgeon of Stockton, California, and Dr. Emmet Lane Rixford, a surgeon in San Francisco.

His was an unusually active and useful life full of zest for enjoyment, mingled with constant devoted service to his fellow men. No man, however poor, was ever denied the privilege of his skill. His service to the destitute sick of San Francisco is incalculable. When payment was possible, his requests were moderate. No man whose life I have saved shall mortgage his remaining existence to me. He builded for himself an enviable monument of gratitude in the hearts of his fellow men. Many mourn his passing, few shall see his like again.

EMILE HOLMAN

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

IN the preface to the first edition of his book,<sup>1</sup> Magnuson states that it was written to meet the needs of the man who first sees the fracture. In the preface to the third edition, he reiterates this statement and emphasizes his purpose of calling attention to fundamental principles in diagnosis and treatment. Dr Magnuson succeeds to a remarkable degree in accomplishing just what he intended to do.

The first 4 chapters discuss the fundamentals of diagnosis and treatment, the pathology and repair of fractures, the mechanism of reduction and maintenance of reduction, and fixation apparatus, both splints and plaster dressings. These preliminary chapters contain much helpful information and sound general principles of fundamental importance in fracture treatment.

The 21 following chapters discuss individual fractures in all regions of the body. As each region is taken up, the consideration of the individual fractures is preceded by brief but adequate remarks on the anatomy of the part and the manner in which muscle pull affects the displacement of the fragments. If joints are involved, joint movements are described and the effect which the various fractures have upon joint function is brought out. Each type of fracture is adequately discussed, usually in considerable detail. The subject matter throughout is sound, logical, and thoroughly conservative in viewpoint.

Complete as this book is, there are certain omissions which should be mentioned and some statements which will not find universal acceptance. In the description of plates for use in the internal fixation of fractures, no mention is made of vitallium, a metal which is being used very widely and with considerable satisfaction. In the description of fractures of the acetabulum, no mention is made of dislocation of the hip joint with fracture of the posterior superior rim of the acetabulum, a very common fracture today as a result of automobile accidents. In the description of treatment of central dislocation of the head of the femur, no mention is made of lateral traction by a Kirschner wire passed through the trochanter, combined with longitudinal traction, this is a very valuable form of treatment. In the description of the treatment of fractures of the shaft of the femur, no mention is made of the use of internal fixation, yet this is being very widely used today. Fractures of this lower articular surface of the tibia, sometimes called posterior marginal fracture, comprising about 19 per cent of all ankle fractures, are very inadequately discussed, in view of the fact that this is a very difficult fracture to

reduce and maintain and results in marked disability if not adequately reduced. The statement that Volkmann's ischemic contracture is the result of tight splinting is today not generally accepted, as hemorrhage within the deep fascia is considered to be the most frequent cause of the condition.

The 2 final chapters deal with physical therapy and exercise in the treatment of fractures. This very much neglected part of fracture treatment is excellently and concisely covered and these chapters are full of helpful information and suggestions.

The general setup of the book is very pleasing. It reads easily, the type is large, and the illustrations are excellent and really explanatory. (It should be noted that Figure 217 is placed upside down.) The bibliography is very complete.

Dr Magnuson, relying upon his broad experience and his extensive material, has succeeded in writing a book which attacks the problem of fractures and fracture treatment in a very direct and enlightening way. It is an excellent treatise which can be highly recommended not only to those who treat fractures occasionally but also to those who make fracture treatment an important part of their practice.

FRANK D. DICKSON

IN its first edition *The Physiological Basis of Medical Practice* by Best and Taylor<sup>2</sup> rapidly became one of the foremost textbooks of physiology and has been widely used both by medical students and as a reference book. The second edition contains several revisions and the addition of a section on special sense physiology. In the preface the authors state that in the first edition they had not considered special sense physiology as being essential but that they had been prevailed upon to include it in the second edition. It is certainly a worth while addition and makes the book complete. Like the first edition it is written in a style which is easy to read and understand, and each section is generously illustrated. With the recent additions it should continue to be one of the outstanding texts in the field.

J. ROSCOF MILLER

THE text by Vinson<sup>3</sup> on diseases of the esophagus and their treatment is entirely new in its field. To the reviewer's knowledge it is the first attempt to present the subject in monographic style.

<sup>1</sup>THE PHYSIOLOGICAL BASIS OF MEDICAL PRACTICE. By Charles Herbert Best M.A., M.D., D.Sc., F.R.S., F.R.C.P. and Norman Burke Taylor M.D., F.R.S., F.R.C.S., F.R.C.P. and Norman Burke Baltimore The Williams & Wilkins Co. 1939.

<sup>2</sup>THE DIAGNOSIS AND TREATMENT OF DISEASES OF THE ESOPHAGUS. By Porter P. Vinson, B.S., M.A., M.D., D.Sc., F.A.C.P. Springfield Ill. and Baltimore Md. Charles C. Thomas 1940.

<sup>3</sup>FRACTURES. By Paul B. Magnuson, M.D., F.A.C.S. 3d rev. ed. Philadelphia, Montreal, London J. B. Lippincott Co. 1939.

The book is but only 300 pages but it is filled with worth while data and material collected from 30 years experience and over 3,000 cases of abnormalities of the esophagus. One of the most interesting of the 6 chapters is given over to the general management of patients suffering from difficulty in swallowing—a subject of interest to the general practitioner as well as to the specialist in solving the many problems that arise during the management of these cases. Feeding is of paramount importance in patients with esophageal obstruction and Dr. Vinson has made many suggestions regarding this factor. Cardiospasm often presents difficulties, especially in the young, and one must know all the methods used in treatment. The relative merits and indications for the different methods are discussed. Chapters dealing with carcinoma of the esophagus, fungus infections, and foreign bodies as well as a chapter devoted to the use and possibilities of gastroscopy are included.

This book is easy to read, is presented in plain language and very little space is devoted to detailed pathological description. The illustrations are practically all taken from photographs or x-ray films and serve as a ready guide to the descriptive text. The book is a welcome addition to the study of diseases of the esophagus, and is sure to be read with a great deal of interest by those specializing in diseases of the esophagus.

JOSEF F. DRAKE

THE book *Surgery of the Hand* should be of great use to the practicing physician, for the author has clearly explained excellent methods for examination and care of injuries of the hands.

A complete chapter is devoted to nerve and tendon diagnosis and repair. The text has very pointedly brought out the economic loss resulting from poor management of injuries of the hands. The last part of the book concerns itself with the most common infections encountered and their management.

With both injuries and infections there are pertinent drawings to illustrate the important points. The final chapter on Anesthetics is excellent.

The author has used considerable space discussing reputation but has failed to outline the management of social space infections. The text is hardly detailed enough for student use but should be of great value to surgeons treating injuries and infections of the hand.

HARVEY S. ALLEN

THE original text of *Thomson and McEwen's Manual of Surgery* now in its ninth edition dates back to 1904. Twenty-eight members of the University of Edinburgh have collaborated with the two editors in producing the present edition. Volume deals mainly with general surgical principles. Volume II is arranged on regional basis with special emphasis

MEMBERS OF THE BOARD: JOHN PRACTICAL SURGEON, By John Russell Crook, M.D., F.R.C. (Edin.) Foreword by W. E. Gibson, M.D., F.R.C. (Edin.) Editors: The University of Edinburgh, 1931. "DIPLOMA IN SURGERY," THOMSON AND MCEWEN'S MANUAL OF SURGERY, By Alexander McEwen, M.D., LL.D., F.R.C. (Edin.), and The Late Sir David W. Thomson, M.D., LL.D., F.R.C. (Edin.) London: Oxford University Press, 1932.

upon diseases as they affect the various sections of the body.

The section on neurological surgery is especially noteworthy as several chapters have been allotted to diseases of the central nervous system and have been handled in masterly style. The section on diseases of the thyroid gland is dealt with more efficiently than in most textbooks of surgery. It is interesting to note the definite Plummer influence regarding the so called "primary and secondary hyperthyroidism. Diseases of the breast are investigated carefully, and the free use of pictures makes the section dealing with this subject more interesting. An excellent chapter on diseases of the peritoneum is presented, a subject which is treated more or less superficially in many textbooks of surgery.

While in general the chapter on appendicitis is satisfactory yet the reviewer finds it fault that it is so prevalent in other surgical volumes namely as a premise is quoted "The symptoms of appendicitis appear in definite order which is highly characteristic (1) pain, (2) nausea, (3) vomiting, (4) tenderness and rigidity, (5) rise in pulse rate and temperature (Murphy)." Unfortunately however too many cases of appendicitis lack one or several of the so called cardinal symptoms, and too often medical student and even in the practice of medicine as well are led astray to the detriment of the patient because the categorical sequence of events is lacking. An excellent description of obstructive appendicitis is given which is too often lacking in surgical volumes. Likewise retrocecal and pelvic appendicitis, appendicitis in children and in patients past the sixtieth year are thoroughly examined. The subject of chronic appendicitis is given unusual prominence and is a worthy contribution.

While diseases of the stomach, duodenum, and intestines are rather sketchily covered the subjects are handled fairly well. On the other hand, diseases of the gall bladder common duct and pancreas should receive more prominence.

Throughout the two volumes much emphasis is placed upon the pathological picture and though treatment is given the signs and symptoms leading to the diagnosis of any given disease are placed uppermost.

EARLE I. GRIFFIN

IN some 350 pages Dr. Riddell has thoroughly covered the subject of blood transfusion as it is met in clinical use. He has omitted much recently accumulated data which are of interest only to those actively engaged in research. The sections on blood preservation and blood plasma are out of date but this fact is undoubtedly due to the very active work going on in these fields.

Readers should be warned against adopting the policy of the voluntary donor agencies in England in which donors have Wassermann reactions done

THOMSON'S MANUAL OF SURGERY, Volume I, Foreword by David Barclay Riddell, M.D., F.R.C. (Edin.) London: Oxford University Press, 1932.

after every tenth transfusion. Although possibly practical in a voluntary system, such methods are not acceptable in this country, especially since any medical student can be taught to perform flocculation tests easily and efficiently.

In general, the conclusions and recommendations of the author concerning problems not yet definitely settled are sound and logical.

THOMAS C DOUGLASS

IN epitome fashion *Industrial Hygiene*<sup>1</sup> covers the field of industrial medicine. Half of the content of this book of 661 pages devoted to clinical medicine, includes such subjects as physical examinations, tuberculosis, cardiac disorders, peripheral vascular diseases, dermatitis, eye injuries, traumatic surgery, neuropsychiatric problems, physical therapy, and rehabilitation. These chapters could well be incorporated in any general synopsis of medicine. Industrial hygiene, as commonly understood, is covered in chapters on silicosis, heavy metal intoxication, gases and fumes, lighting and atmosphere, while topics of general interest, such as scope of health service, the nurse in industry, railroad medical care, health education, compensation, statistical considerations of accidents and diseases, receive due attention.

Obviously such a replete volume must suffer because of brevity. Some compensation has resulted from a well chosen staff of authors. With many interrelated discussions there is some difference of opinion which is well tolerated.

This volume presents a review of the common medical problems met in industry. It is a good clinical review of medicine, presenting some of the aspects of the field of industrial hygiene. It may, with profit, be read by anyone interested in industrial practice.

EUGENE L WALSH

THE third edition of the *Mechanics of the Digestive Tract*,<sup>2</sup> which has been practically doubled in size and completely rewritten and extended in its scope of usefulness, is truly an introduction to gastroenterology. Dr Alvarez's extensive background in physiological research and clinical medicine, combined with his genius in presenting his thoughts in a most readable style, is exemplified throughout the volume.

This book makes available for students, teachers, general practitioners, internists, and surgeons information about clinical physiology of the gastrointestinal tract which will be of great aid in sound diagnosis and treatment.

Today's conception of the control of the pylorus, innervation of the colon, and polarization of the bowel and gradients are presented in a crystallized manner. In addition, one finds the explanation of

many of the practical problems of gastro-intestinal disease seen in daily practice such as hunger contractions, vomiting, ulcer pains, flatulence, reverse peristalsis and its symptoms, rate of progress of food residues, and movements of the diseased stomach.

To the tired and hurried practitioner, Alvarez has offered a summary at the end of each chapter where a brief answer to some question can be quickly obtained.

A chapter on technical methods and apparatus and visualized illustrations should be found very useful to laboratory workers.

The chapter on the source of books and articles of reading gives the student and young physician a quick entry into the several phases of gastroenterology and gastro-intestinal physiology. This chapter combined with an extensive bibliography will definitely aid in finding the most important papers, books, and review articles in the field.

I know of no other book that serves in such a unique manner as a real introduction to gastroenterology. I am sure after reading it that the application of its theories in the treatment of gastro-intestinal disease in daily practice will be more scientific and less empirical.

CLIFFORD J BARBORKA

UNDER the title of *Cardiovascular-Renal Disease*,<sup>3</sup> the Temple University collaborators discuss essential hypertension, arteriosclerosis, nephritis, and the other closely related conditions. Cardiovascular-renal disease as the chief cause of death in the individual over 45 years old deserves this concise, clear presentation, especially in view of recent drastic changes in our concept of this interrelationship. Goldblatt's discovery that ischemia of the kidney may be a large factor in the production of essential hypertension has led to a vast new literature on this entire subject. Evidence of the renal origin of hypertension is found in the preponderance of sclerosis of the kidney arterioles in cases of essential hypertension, and the occasional relief of hypertension by the removal of a unilateral pyelonephrosis.

The available material on glomerulonephritis, nephrosis, and toxemia of pregnancy has been digested and is presented to the student in a logical and easily assimilable form. As the authors state, "There is nothing in the entire presentation that can be termed original, except for the pooling of the medical, ophthalmological, and the pathological experience of the group." Chapters discussing the disease subgroups are followed by illustrative case studies with excellent photographs of the essential, gross, and microscopic pathology. Throughout, the importance of ophthalmoscopy is stressed, for "the ophthalmoscope is just as valuable an instrument in

<sup>1</sup>INDUSTRIAL HYGIENE. By various authors. Edited by A J Lanza, M.D. and J A Goldberg, M.A. Ph.D. New York, London and Toronto Oxford University Press, 1939.

<sup>2</sup>AN INTRODUCTION TO GASTRO-ENTEROLOGY. Being the third edition of the *Mechanics of the Digestive Tract*. By Walter C Alvarez M.D. New York and London Paul B Hoeber Inc 1940.

<sup>3</sup>CARDIOVASCULAR RENAL DISEASE. A CLINICOPATHOLOGIC CORRELATION STUDY EMPHASIZING THE IMPORTANCE OF OPHTHALMOSCOPY. By Lawrence W Smith M.D., Edward Weiss M.D., Walter L Lillie M.D., Frank W Konzelmann, M.D. and Edwin S Gault, M.D. New York and London D Appleton Century Co Inc. 1940.

the study of the patient with hypertension, including eclampsia, as renal functional tests are to the patient with nephritis. However their classification of the retinal vascular changes is somewhat confusing and is less practicable than others in our experience.

One is impressed by the simplicity and clarity of the authors' presentation of the topic, cardiovascular-renal disease. This quality is no doubt partly due to the fact that the book is based on material from a scientific exhibit, an exhibit which was awarded the Frank Billings Gold Medal at the annual meeting of the American Medical Association in San Francisco in 1938.

All students of the vascular diseases probably will not find themselves in agreement with the views or interpretations which are held by this Philadelphia group but the book may certainly be commended as being another attempt on the very live and difficult subject of cardiovascular disease.

M HERBERT BARKER

THE book, *Diverticula and Diverticulitis of the Intestine* is a compilation completely covering the subject of diverticula and diverticulitis of both small and large bowel. In four sections the author presents congenital diverticula, diverticula of the duodenum, diverticula of the jejunum, and diverticula of the large intestine. In each type of lesion he is able to present abundance of material for illustration from both the anatomic and pathological viewpoint as well as the present x-ray films for diagnostic study.

Diverticula of the small bowel, including even Meckel's diverticula, are seldom encountered serious surgical problems in connection with them are infrequent and for that reason one rarely finds a comprehensive presentation of these lesions such as is here given.

The section on diverticulosis and diverticulitis of the colon covers this subject very thoroughly and because the disease is less frequent than malignancy it is usually but incompletely presented in texts devoted to colon surgery. The author has written in detail the complications of diverticulitis, such as abscess, fistula, obstruction, et al. and has taken the pains to present the therapeutic problems involved in the treatment of these complications. To the surgeon not too experienced with these very serious lesions, this section of the book will prove very valuable.

The drawings and photographs, of which there are many, are excellent. Surgical technique is not illustrated. The subject matter is well written and clearly presented and the reviewer regards this volume as valuable reference work on a subject which causes many surgical heartache.

J R BUCHENBERGER

"DIVERTICULA AND DIVERTICULITIS OF THE INTESTINE, JOHN F. VOHL, Chief, Department, and T. S. FLETCHER, By Harold Edwards, M.D. (Lond.), F.R.C.S. (Eng.). With Illustrations by Gordon Gordon Taylor O.B.E., M.B., Ch.B., Baltimore, Md. The Williams & Wilkins Co. 1939.

IN response to the desire expressed by his students for an evaluation of the various methods for the surgical treatment of congenital cleft lip and palate, Dr. Vaughan<sup>1</sup> has succeeded admirably in compiling a book in which they will find "the subject concisely covered in one treatise."

In aiming to make the book of practical use to the interested general surgeon, pediatric surgeon and the specialist in plastic and reconstructive surgery the author has done well to call attention to the unsuccessful operations and the difficulties which are to be overcome. This emphasis is important because operations to correct these deformities are judged, perhaps above all others, on the cosmetic and functional results.

The subject matter is set forth in good form, and the sections devoted to embryology, anatomy and physiology are excellent.

In evaluating the various operations the author is most fair and credit has been generously given. He himself, has made worth while contributions to the plans for managing wide unilateral cleft palates and also the premaxilla in double cleft lip closure.

Prominence has been given to the matter of secondary operations and corrections, and the author is to be commended for the manner in which he has dealt with this subject.

Of especial interest is the chapter on palate lengthening and velopharyngeal closure, development in cleft palate surgery tending toward greater functional perfection.

The importance of postoperative supervision of all repaired cleft palates is emphasized and attention is directed to speech training, orthodontic treatment to care for the developing alveolar arches and the teeth, and last but not least, a desirable co-operation with the dentist who may be called upon to construct various appliances necessary to correction of deformities.

All in all this book is a splendid contribution, written in form of use to all interested in cleft lip and palate correction. FARMINGTON, W. ALLEN.

THE second edition of a most practical orthopedic handbook, *Handbook of Orthopedic Surgery* by Alfred River Shands, differs from the first edition (1937) in several ways. It is a smaller volume because of the improvement in the texture of paper. There are about 30 pages less in this edition and the volume is three-fourths as large. The text has been slightly altered to include new material and to omit irrelevant matter. The bibliography is excellent and has been brought up to date (July 1939) it still ranks as one of the most modern orthopedic bibliographies available.

The illustrations, chiefly pen and ink drawings, are clear descriptive, and the plates many.

"CONGENITAL CLEFT LIP, CLEFT PALATE AND ASSOCIATED NASAL DEFORMITIES. By Harold Vaughan, Vaughan, M.D. Ch.D. Philadelphia, Pa. F. & J. Taylor 1939.  
"MANAGEMENT OF ORTHOPEDIC SURGERY. By Alfred River Shands, Jr., M.D. In collaboration with Richard Bennett Bailey, A.A. M.D. St. Louis, The C. Mosby Co. 1939.

changes have been made in them from the first edition with additions, deletions, reductions in size, and new drawings. The instructive illustrations greatly enhance the value of the volume.

There are 24 chapters arranged in a manner ideal for teaching purposes. The authors express the views of contemporary orthopedic literature, textbooks, and teachers, in a concise factual manner.

The manuscript is well seasoned with theory and practical experience. There is no need to review the subject matter because it is pure fundamental orthopedic surgery in its complete scope.

Medical students, nurses, physical therapists, general practitioners, and orthopedic teachers will find this handbook the best available book on the subject for their requirements. SIDNEY SIDEMAN

FOR many years the *New England Journal of Medicine* published reviews of recent contributions covering various branches of medicine. These presentations for the year 1939, compiled and edited by Robert N. Nye, are published as *Reports on Medical Progress*<sup>1</sup>.

The subject matter of these progress reports includes many of the commonly encountered problems of general medicine and surgery and the specialties. Fifty-two well chosen authors contribute to this work. In general, the reports are brief and accurate summaries of the more recent diagnostic and therapeutic aspects of the selected subjects. A limited number of references accompany each chapter. No attempt is made to include anything approaching a meticulous review of the literature.

The book is well bound and is printed in a type size that lends itself to easy reading. This type of year book will be of value not only to the general practitioner but also to the specialist who wishes to keep in contact with advances in fields of medicine other than his own. FRED FITZ

FOR the most part *Shock, Blood Studies as a Guide to Therapy*<sup>2</sup> by John Scudder represents a study of one aspect of the complicated problem of shock, that of hydration and the rôle of potassium and the cortical hormone. The first part of the book deals with historical and experimental aspects and considers 4 theories of shock and 35 methods of treatment dating back to the days of John Hunter. A great deal of information is presented concerning the changes in the blood constituents with emphasis upon the potassium ion, its pharmacological action, and its increased concentration in the serum in certain types of shock. The importance of constant observation of the state of hydration of the patient and the aid given by cell volume, specific gravity of blood and plasma, and plasma protein determination is presented with a few illustrative cases. The im-

portance of vascular dynamics of shock is less carefully considered. The author holds to the debatable view that vasoconstriction in shock is a harmful factor in promoting fluid loss and peripheral hemoconcentration. The important physiological rôle of vasoconstriction as one of the natural defense mechanisms of the body against fluid loss and shock is not mentioned.

The second part of the book consists chiefly of a case history presentation of 28 patients in various stages of circulatory collapse. They were treated with blood transfusions, salt solutions, and a proprietary cortical extract. The author believes that in shock with hyperpotassemia the use of sodium salts and cortical extract has been shown to be beneficial. He states that shock is not due to potassium poisoning alone but that alterations of potassium serve as a measure of profound cellular changes. He also suggests that the administration of large amounts of preserved whole blood high in potassium may be harmful in patients with hyperpotassemia.

The third part of the book deals with historical development and a bibliography. Brief abstracts on the conception and treatment of shock show the recent trend toward abandonment of the toxic theory, questioning of the nervous and cortico-adrenal theory, and almost universal acceptance of the importance of circulating blood volume changes in the development of shock. Reports on the physiological and toxicological effects of potassium and on the function of the adrenal glands are also briefly abstracted.

This book has well emphasized the importance of a constant watch of the state of hydration of patients in vascular collapse. Although the presentation of the problem of shock is not entirely complete, information with regard to blood changes in shock and the suggestion of a therapeutic relationship between hyperpotassemia and cortical extract of the adrenal glands are presented. KEITH S. GRIMSON

ALL too frequently books on the specialties, composed of chapters on special topics by various contributors, suffer the effects of redundancy, repetition, overlapping of material, and even conflict of statements. From such faults *Injuries of the Skull, Brain and Spinal Cord*<sup>3</sup> is singularly free, which bespeaks a careful and competent editorship. The 23 contributors to this volume have co-ordinated successfully for the production of a well organized book which is certain to find widespread use and appeal, since there is a genuine need for such a reference source.

Trauma to the scalp, skull, meninges, brain, spine and cord is discussed in its surgical, neuro-psychiatric, and medico-legal aspects. The reviewer found the chapter on concussion and contusion of the brain, by C. P. Symonds, especially informative and useful in clarifying this elusive subject, most

<sup>1</sup>REPORTS ON MEDICAL PROGRESS 1939, as published in the *New England Journal of Medicine*. Compiled and edited by Robert N. Nye. M.D. Boston: Little, Brown & Co. 1940.

<sup>2</sup>SHOCK, BLOOD STUDIES AS A GUIDE TO THERAPY. By John Scudder. M.D. Med.Sc.D. F.A.C.S. Philadelphia, Montreal, London: J. B. Lippincott Co. 1940.

<sup>3</sup>INJURIES OF THE SKULL, BRAIN AND SPINAL CORD. NEURO-PSYCHIATRIC SURGICAL AND MEDICO-LEGAL ASPECTS. Edited by Samuel Brock. Baltimore: The Williams & Wilkins Co. 1940.

discussions of which are unsatisfactory. The etiology of post-traumatic neuroses is given a fresh and liberal treatment (p. 276) and though one need not especially adopt this particular theory of pathogenesis sound as it may seem, any more than one need adopt the use of celluloid plates in the repair of cranial defects (p. 200) or other specific suggestions offered by the various contributors, yet each subject has been treated in a rational, modern manner according to the best experience of the individual. Fortunately a minimum of case reports has been employed to illustrate the various topics of discussion. Elsberg's chapter on spinal cord injuries is an example of the outstanding accomplishment of this book viz. to be informative to supply readily useful instruction, without being pedantic or arbitrary.

Each chapter is followed by a selected bibliography. Most of these references are within the last decade, indicative of the recent interest in and importance of the subject of trauma to the central nervous system.

JOHN MARTIN.

A CAREFULLY prepared study of the problem of shock is presented in *Shock and Related Capillary Phenomena* by Virgil H. Moen. The book is written primarily from a pathological point of view. The term "shock" is used in a broader sense than that usually considered in surgical literature and relationship is brought out between the late or irreversible stages of surgical shock and death from other causes, such as infections and asphyxia. In this respect the detailed information relating to capillary atony and tissue anoxia is an important contribution to an understanding of shock.

SHOCK AND RELATED CAPILLARY PHENOMENA. By Virgil H. Moen. A. B. M. Sc., M. D. London, New York, Toronto: Oxford University Press, 1932.

The contributory factors that lead to this later stage of tissue anoxia are considered. The author is well justified in his statement that these factors may be diverse. This is especially true in death in conditions other than surgical shock. In surgical and in traumatic shock the author defends the conception developed during and just after the World War that toxic agents absorbed from injured areas may be a major factor in the development of shock. The theory is offered that toxic injury to the capillaries may lead to capillary atony reduced blood volume reduced volume flow reduced delivery of oxygen, and finally tissue anoxia which in turn directly or indirectly through toxic products further contributes to the original capillary atony. The experimental evidence for and against the theory of toxic toxinemia is presented, and the more generally accepted evidence against it and for blood or serum loss as a major factor is severely criticized. In this connection it should be stated that clinical experience is greatly reducing the incidence of surgical shock by adequate hemostasis, the employment of operation in bloodless fields under tourniquet, early and adequate blood transfusions and careful postoperative management of fluid balance is the best evidence that toxinemia in these instances is not a major factor.

The factors of the late stage of shock are well considered in this carefully prepared and comprehensive book. The factors leading to this late stage remain complex and are probably multiple in many instances. The author although probably overemphasizing the rôle of traumatic toxinemia, has certainly produced a book on shock and its relation to capillary damage that is well worth reading.

KETHE GREENE

## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

PRINCIPLES OF SURGICAL CARE: SHOCK AND OTHER PROBLEMS. By Alfred Blacklock, M. D. St. Louis. The C. V. Mosby Co. 940.

THE PRINCIPLES OF ANATOMY: AN INTRODUCTION TO HUMAN BIOLOGY. By A. A. Abbe, M. D. B. S. B. Sc. (Sydney). Ph. D. (London). Sydney and London: Angus & Robertson Ltd., 1930.

FIVE YEAR STATISTICAL REPORT FROM THE CHESTER HOSPITAL AND HOME RADONUM INSTITUTE, MANCHESTER, ON THE RESULTS OF RADONUM THERAPY FOR THE YEARS 1927 AND 1928. Stockport: Rowland Berry & Co. Ltd. 930.

A TEXTBOOK OF HISTOLOGY. By Harvey Ernest Jordan. A. M. Ph. D. School. New York and London: D. Appleton-Century Co. Inc. 940.

A HANDBOOK FOR DESTRUCTORS. By J. C. Boulton Grant and H. A. Cates. A Companion to *A Method of Autopsy* by J. C. Boulton Grant. Baltimore: The Williams & Wilkins Co. 940.

A METHOD OF ANATOMY: DESCRIPTIVE AND DESCRIPTIVE. By J. C. Grant, M. C., M. B., Ch. B., F. R. C. S. (Eden) and J. C. Boulton Grant. The Williams & Wilkins Co. 940.

THE SCIENCE OF THE ALIMENTARY T. ACT. By Sir Hugh Davies, M. S., F. R. C. S., F. A. C. S. Baltimore: The Williams & Wilkins Co. 940.

THE ERA KEY TO THE USP VI & NF VI. Revised by Lyman D. Fother. 5th ed. Newark, N. J.: The Haynes & George Co., Inc., 930.

JAMES ANNESLEY (1780-1847) An Irishman, whose thirty-seven years as a military surgeon in India aided Britain to extend the Empire, a meticulous recorder of the symptoms of disease, remedies used and the results obtained, knighted by Queen Victoria





# SURGERY

## GYNECOLOGY AND OBSTETRICS

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### THE RELATION OF "CHRONIC MASTITIS" TO CARCINOMA OF THE BREAST

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**D**OES a given woman whose breast shows evidence of changes commonly described as chronic mastitis have greater chance of developing carcinoma than one with normal breasts? The problem which faces us is the importance of cystic disease as an etiological factor in carcinoma of the breast. Is the probability of a breast with chronic mastitis developing carcinoma sufficiently great to warrant simple mastectomy or even bilateral mastectomy, is it sufficiently slight to discard all fear and all caution or must a middle ground be taken? We have yet to find an authoritative opinion on this problem which so frequently confronts both surgeon and pathologist. This question would seem an easy one to answer and indeed many believe that they have solved it.

The present study was undertaken in an effort to present at least a partial answer in the hope that it might lead to a more complete solution ultimately. For this purpose a group of women, who had had portions of breast removed as a result of various symptoms, were followed for at least 5 years and the incidence of carcinoma was compared with that of the general female population.

In view of the many terms applied to the various lesions of the breast, a very brief historical review may be helpful in orientation.

#### HISTORICAL REVIEW

Apparently the first association of cystic disease of the breast and carcinoma was made by Astley Cooper, who in 1845 in his *The Anatomy and Diseases of the Breast* records their coexistence.<sup>1</sup> While Brodie considered mammary cysts benign, he pointed out that they might recur, and that their presence does not rule out carcinoma. Billroth regarded the cysts as essentially the result of retention. Reclus considered the cysts to be neoplastic, but benign, although he admitted the possibility of the development of carcinoma from them in older women. He emphasized the bilateral character of the lesion. Careful study of the cysts led Brissaud to believe proliferation of the glandular epithelium the major factor in their formation. Schimmelbusch believed the cystic condition to be a true tumor and gave it the name of "cystadenoma mammae." In 3 cases of 43 Schimmelbusch found carcinoma. Three cases of carcinoma developing in cystic breasts were also reported by Sicre. The term "chronic cystic mastitis" was first applied by Koenig, who believed the process to be inflammatory and

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<sup>1</sup>Cited by Cheate and Cutler.

TABLE I.—THE RELATION OF FIBRO ADENOMATOSIS MAMMÆ TO THE DIFFERENT DEGREES OF CANCER DEVELOPMENT (GROUPS I TO IV) (FROM SEMB)

	Fibro-adenomatous masses (macroscopic)				Fibro-adenomatous cysts (samples)				Fibro-adenomatous cysts (populations)				Fibro-adenomatous cysts (samples + pop. findings)			
	No. of cases	%	Average age	Subtotal proportion	No. of cases	%	Average age	Subtotal proportion	No. of cases	%	Average age	Subtotal proportion	No. of cases	%	Average age	Subtotal proportion
Group I. Fibro-adenomatous cysts without and without growth (i. without signs of carcinoma)	42	96	43 yrs		37	8	43 yrs	8	37	41 yrs		54	4	37 yrs	8	
Group II. Fibro-adenomatous cysts suspected of or reported as carcinoma (i. suspected of carcinoma)			42 yrs		24	19	42 yrs		30	37	41 yrs		24	44	41 yrs	
Group III. Fibro-adenomatous cysts with recurrent nodulating growth (i. with carcinoma suspected)					5	13 yrs			5	5	34 yrs				37 yrs	
Group IV. Fibro-adenomatous cysts with pronounced nodulating growth (i. with carcinoma manifest)			38 yrs		26	37 yrs			25	37 yrs			19	19	40 yrs	
Total cases	42	100	43 yrs		92	37 yrs		8	97	37 yrs			97	100	41 yrs	

\*Carcinoma on the other side and "clinical bilateralism" not selected

considered the epithelial proliferations as distinct from the cystic process. The epithelial proliferations within the cysts were emphasized by Tietze who found cancer in 10 per cent of his cases. Ten per cent of Greenough and Hartwell's (16) 30 cases of cystic disease showed carcinoma. This change named "adenomatous proliferation" by Warren, coexisted with carcinoma in 15 of 507 cases of breast cancer he reported. In Bloodgood's (5) first paper (1906) he called the condition "simple parenchymatous hypertrophy." He at that time regarded the adenocystic form as precancerous although he subsequently altered his opinion and finally considered carcinoma to develop no more frequently in this lesion than in the normal breast.

this cyst formation transition to carcinoma might occur fairly frequently although only a small proportion of the mammary carcinomas developed from chronic cystic mastitis.

Greenough and Simmons (7) found an incidence of 4.8 per cent of carcinoma developing 1 to 17 years after excision of diseased foci from breasts the site of cystic disease.

Chronic cystic mastitis was regarded by Deaver and McFarland as abnormal involution. They recognized that the large pale epithelial cells regarded by some (20, 32) as of sweat gland origin were produced by abnormal involutional changes. In examining 575 breasts removed for tumor 335 of them can

TABLE II — ASSOCIATION OF FIBRO-ADENOMATOSIS CYSTICA WITH CANCER (FROM SEMB)

Group I Fibro adenomatosis cystica—without signs of infiltrating growth		
a Fibro-adenomatosis cystica simplex	43 cases out of	73
b Fibro-adenomatosis cystica papillomatosa	10 cases out of	27
Total	53 cases out of	100
Group II Fibro adenomatosis cystica, suspected of incipient infiltrating growth (suspected of carcinoma incipiens)		
a Fibro-adenomatosis cystica simplex	14 cases out of	73
b Fibro adenomatosis cystica papillomatosa	10 cases out of	27
Total	24 cases out of	100
Group III Fibro-adenomatosis cystica with incipient infiltrating growth (with carcinoma incipiens)		
a Fibro adenomatosis cystica simplex	9 (8) cases out of	73
b Fibro adenomatosis cystica papillomatosa	5 cases out of	27
Total	14 (13) cases out of	100
Group IV Fibro-adenomatosis cystica with pronounced infiltrating growth (with developed carcinoma)		
a Fibro-adenomatosis cystica simplex	8 cases out of	73
b Fibro-adenomatosis cystica papillomatosa	2 cases out of	27
Total	10 cases out of	100

One of the most careful studies is that of Semb, who analyzed a series of 144 cases of fibro-adenomatosis with coexistent cancer in a few. In 122 cases of carcinoma there were fibro-adenomas as well. His findings are summarized in Tables I and II. Carcinoma was present in 24 per cent of the group showing definite hyperplasia. On the basis of these he concludes "The greatest importance must be attached to the relation to cancer."

McGlannan cited 3 instances of carcinoma of the breast coexistent with blue-domed cysts in a series of 100 breast cancers, and 5 showing cancer developing in a papillomatous cyst.

Cheate and Cutler hold that 20 per cent of the cases of breast carcinoma arise on the basis of "cystiferous desquamative epithelial hyperplasia." They give no figures, however. In discussing a paper by Whitehouse on chronic mastitis, Cutler states that "at least 20 per cent of carcinomas have passed through the cystic and papillomatous changes."

Dietrich believes the breast in chronic cystic mastitis to be chronically inflamed as a result of abnormal involution. Sixty-eight, or 30 per

TABLE III — TORONTO CASES BY YEARS, SHOWING INCIDENCE OF CANCER FOLLOWING DIFFERENT LESIONS

Year	Chronic cystic mastitis		Chronic mastitis		Duct papilloma	
	Total	Devel-oped cancer	Total	Devel-oped cancer	Total	Devel-oped cancer
1920	16	1	6		1	
1921	19		10		3	
1922	24		8	1	1	
1923	31	2	14		4	
1924	18		9		6	
1925	28		13	1	5	
1926	36		13		5	
1927	41	1	12		11	
1928	60	2	13		12	1
1929	61		18	1	11	
1930	69	1	12		12	1
Total	403	7	128	3	71	2

cent, of 233 cases of chronic cystic mastitis showed coexistent cancer.

Under the term "cyclomastopathy" fibro-adenomas and related lesions are considered by Oliver and Major, who found only 1 case of carcinoma developing among 106 cases followed over 5 years.

Campbell followed a group of 190 cases of simple cystic disease treated by local excision, 62 per cent for 5 years or more, and found 1 carcinoma of the breast as well as 1 case in which the patient was dying from carcinoma of unknown origin. Of 42 cases of adenocystic disease, 52 per cent were followed 5 years or more and no cases of carcinoma were found. Simple mastectomy was done in 57 patients, of whom 64 per cent were followed 5 years or more. One developed carcinoma in the opposite breast.

TABLE IV — AGE OF TORONTO CASES AS OBTAINED

Diagnosis	Youngest—age in years	Oldest—age in years	Cases	Average age in years
Chronic cystic mastitis	21	64	188	40.9
Chronic mastitis	19	65	75	41.0
Duct papilloma	21	65	43	40.7

TABLE V — MASSACHUSETTS 1930 FEMALE BREAST CANCER AGE SPECIFIC DEATH RATES BY MARITAL STATUS\*

Age in years	Sample		Not sample		Total	
	Deaths Population 1000	Rate per 100,000	Deaths Population 1000	Rate per 100,000	Deaths Population 1000	Rate per 100,000
Under 30	699,418		174,158		873,576	
30-39	68,111		37		68,148	
40-49	30		18		48	
50-59	36,466		136		36,602	
60-69	30		21		51	
70 and over	36,494	108	181,936	65	218,430	
Total over 30	44	130	234		278	
Total all ages	1,116		234		1,350	
Total all ages	1,116		234		1,350	
Total all ages	1,116		234		1,350	

\*Based on the number of deaths from breast cancer deaths occurring in 1930 per 100,000 U. S. Census Population by age and marital status and 1930 life table data for female population.

Among 54 patients on whom partial mastectomy was performed for chronic cystic mastitis and followed from 2 to 12 years Klingenstein found 2 carcinomas of the breast. Eleven of the patients had multiple operations for chronic cystic disease.

The relation of ovarian hormones to chronic cystic mastitis has been considered by many among them Lewis and Geschickter (24) and Taylor who believes that an ovary producing estrin must be present in any case with painful nodular breasts. He also stresses the importance of local vascular congestion in the development of the lesion.

There has been a growing tendency to regard these lesions as not necessarily leading to malignancy. Bloodgood (6) has had much influence in advancing this viewpoint. In 92 he reported subsequent carcinoma developing in only 3 of 28 cases of chronic cystic mastitis treated by local excision. Later in a series

TABLE VI.—DURATION OF FOLLOW UP IN 604 CASES

Age in years	Approximate duration of follow up years
—30	6.9
30 to 39	8.4
40 to 49	8.6
50 to 59	10
60 to 69	
70 to 79	9.4
80 and over	10.0
Unknown	70.5
Total under 30	8.4
Total over 30	9.9

TABLE VII — AGE DISTRIBUTION OF CASES OF BREAST DISEASE FOLLOWED (Age at end of follow-up period)

Age in years	Number of cases
—30	3
30 to 39	6
40 to 49	35
50 to 59	7
60 to 69	27
70 to 79	35
80+	19
Unknown	26

of 500 single blue-domed cysts he found (7) only 5 carcinomas.

A recent article by Lewis and Geschickter (25) further emphasizes this view. Three deaths from breast cancer occurred among 171 cases of adenosis followed more than 5 years and only 1 death from breast cancer among 152 cases of cystic disease followed more than 5 years. In 54 cases in the latter group biopsy had not been done. Their figures will be discussed later in the paper. Based on a study of 2,675 cancers of the breast, they state that only 0.5 per cent of the usual type show in the surrounding breast tissue changes characteristic of Schummelbusch's disease yet 30 per cent of the comedo type of cancer are associated with breast tissue showing these changes. They conclude "These figures would seem to indicate that cystic disease and adenosis are not precancerous lesions and that radical operations should not be performed as frequently as they are. Another form of therapy should be tried."

In this connection Rogers and Nathanoff noted that in half their cases of chronic cystic mastitis treated with endocrine therapy (ovarian residue and/or progynon) palpable lumps disappeared.

## MATERIAL

To carry out this analysis a study was undertaken of women whose breasts had been operated upon in various Boston hospitals. These were supplemented by a study in Toronto by Dr J R E Morgan of a group of 602 women whose breasts had been operated upon in the Toronto General Hospital,<sup>1</sup> 419 of the group being followed for 5 years or more.

The results obtained by Dr Morgan are presented in Tables III and IV.

The 602 cases are arranged by years and diagnoses in Table III, to illustrate the types of lesions encountered and the decreasing tendency to call certain changes "precancerous." Due to duplication of lesions in a single breast, the total of the tabulated lesions—614—does not check with the number of cases—602.

The frequency with which carcinoma developed subsequently in these breasts is shown in Table III. Ten cases of cancer were found, an incidence of 1.7 per cent. In 337 cases a portion of breast tissue less than 3 centimeters in diameter was removed, in the remainder complete unilateral mastectomy was done. In 23 additional cases diagnosed as "precancerous," two breast cancers developed. Of the total 12 cases of carcinoma, 10 are dead and 2 living, 6 and 8 years after operation, respectively.

The ages of these patients could not be obtained with accuracy, and so this group has not been used for detailed study. The average age of the patient is 41 years (see Table IV), which may account in part for the somewhat lower incidence of cancer than was found in the two Boston samples, which had an average age of 52 years.

The Massachusetts group was at first divided in two parts to offset such possible confusing points as variation in popularity of clinics or in types of patients attending different clinics. One group consisted of patients from Boston City, Peter Bent Brigham, and Huntington Hospitals, the other group came from New England Deaconess and Pondville Hospitals and those hospitals using the state tumor diagnosis service. Since no significant

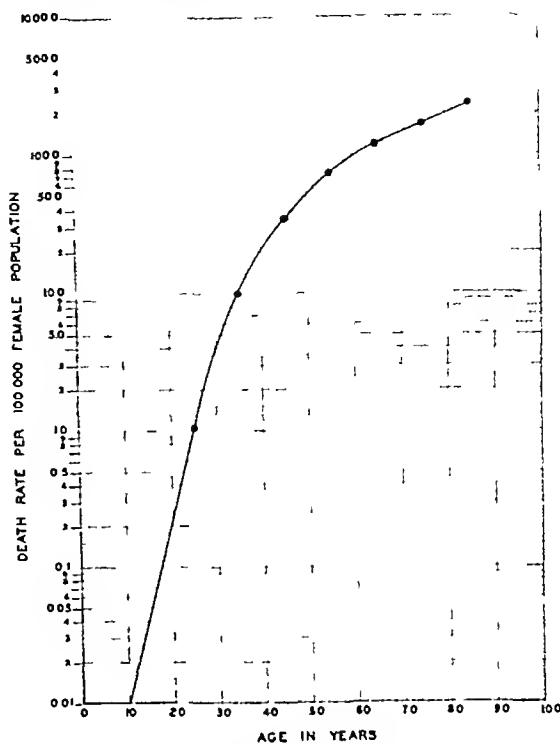


Fig 1 Graph illustrating increase in breast cancer death rate with age. Semi logarithmic scale.

difference appeared in the two samples, they are lumped together in most calculations.

While over 2,500 various non-malignant lesions of the female breast were reviewed in studying the Massachusetts material,<sup>2</sup> follow-up was attempted in about 900, as indefiniteness of identification and length of time elapsed made many cases unsuitable. The periods after operation on the breast in the 604 cases successfully followed ranged from 5 to 21 years. The follow-up periods with most cases are the sixth and seventh years—164—and from the eleventh year on—135.

These cases have been divided, perhaps arbitrarily, into groups of chronic mastitis, 173 cases, chronic cystic mastitis, 340 cases, adenocystoma, 21 cases, and adenofibroma, 70 cases.

The chronic mastitis group is comparable to the fibro-adenomatosis simplex of Scmb.

<sup>1</sup> I am indebted to Drs H M Clute, E M Daland, J Fallon, F H Lacey, C C Lund, L S McKittrick, F Parker, Jr, G W Taylor, V J Walker, S B Wollach and many others for assistance, pathological material and clinical information. To Drs Herbert L Lombard and E B Wilson for statistical advice and aid.

<sup>2</sup> We are indebted to the late Dr Oskar Klotz for permission to use this material.



Fig. 2



Fig. 3



Fig. 4

Fig. 2. Adenocystoma of breast. This mass sheared out of duct beneath the nipple. Simple mastectomy (left) female, 67 years of age, N 37438  $\times 6.5$ .

Fig. 3. Adenocystoma of breast. Note active but orderly epithelium. Associated with marked chronic cystic areas.

Fig. 4. Local excision, female 58 years of age, No. 3935  $\times 30$ .

Fig. 4. Chronic cystic mastitis: multiple small cysts with slight epithelial hyperplasia. Large cysts also present. Local excision, female 45 years of age, N 3782  $\times 7.5$ .

the breast with diffuse or local thickening due to changes of both epithelium and connective tissue. Cysts of microscopic size may be

present. Some of the more marked cases of mastoplasia as defined by Cheate and Cutler would fall into this group.



Fig. 5

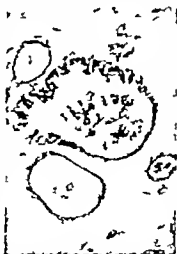


Fig. 6



Fig. 7

Fig. 5. Chronic mastitis: broad-filled phagocytes. Local excision, female 40 years of age, N 36958  $\times 35$ .

Fig. 6. Chronic cystic mastitis. Focus of small cysts with slight epithelial hyperplasia. Local excision. Patient subsequently developed carcinoma of this breast for which radical mastectomy was done. Also had malignant ade-

nomas of descending colon. Female 63 years of age, No. 3673  $\times 30$ .

Fig. 7. Chronic cystic mastitis showing epithelial hyperplasia. Six weeks previously intra-ductal papillary adenocystoma removed. (From same breast.) Simple mastectomy. Female 66 years of age, N 37753  $\times 35$ .

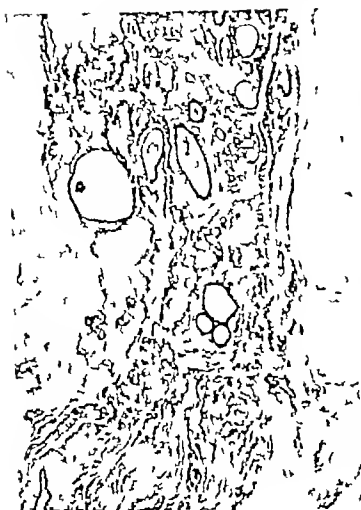


Fig 8

Fig 8 Very slight cystic disease of the microcystic type Local excision, female, 61 years of age, No 44184  $\times 19$



Fig 9

Fig 9 Chronic cystic mastitis with diffuse acinar hyper



Fig 10

plasia Local excision, female, 23 years of age, No 26-1264  $\times 19$

Fig 10 Marked epithelial hyperplasia, precancerous Local excision, female, 20 years of age, No 38876  $\times 120$

Chronic cystic mastitis includes lesions recognized by such descriptive terms as Schimmelbusch's disease, fibro-adenomatosis cystica of Semb, the cystipherous desquamative epithelial hyperplasia of Cheate and Cutler, Aschoff's mastopathia cystica, and the maladie

kystique of Reclus These breasts are nodular due to the presence of one or more cysts with varying degrees of epithelial hyperplasia and papillary ingrowths Clear columnar acidophilic cells may be conspicuous, often with fibrosis and thickening of periductal elastica



Fig 11 Carcinoma developing in chronic cystic mastitis Radical mastectomy, female, 66 years of age, No 28-790  $\times 120$



Fig 12 Intracanalicular adenofibroma of the breast Local excision was performed, female, 32 years of age, No 37806  $\times 19$



The term adenocystoma is confined to true intraductal papillary growths, commonly in the ampulla or larger ducts. It does not include the papillary projections of chronic cystic mastitis.

Adenohroma, or adenoma, is the pseudo-encapsulated tumor so common in adolescence made up of varying proportions of stromal and epithelial elements. They may or may not be intracanalicular in arrangement.

These last two groups are included to provide a contrast to the groups of chronic mastitis and chronic cystic mastitis and will not be considered in all the tables.

Of the lesions present 347 had been treated by incomplete mastectomy, ranging from portions a few millimeters in diameter to 3 centimeters in most even to almost complete mastectomy in rare instances. Complete local mastectomy was done in 163 cases, and conclusions are based in these on the behavior of the remaining breast.

In this study the mode of research was based on three assumptions: first that removal of a lump in the breast which proved on excision to be chronic mastitis or chronic cystic mastitis did not necessarily remove all the abnormal tissue; second that alterations in the breast are frequently produced by hormonal influences which may be fairly assumed to continue to affect at least some other portions of the breast tissue after one portion has been removed; and finally that if chronic mastitis, cystic or otherwise, is a precursor of carcinoma, those women who had this disease, proved by partial or unilateral mastectomies, should have a higher frequency of carcinoma of the breast than women in the general population.

A weak point lies in that supposedly the most abnormal breast tissue has been removed by the biopsy, and thus an artificially low incidence of subsequently developing carcinoma may be obtained. It may also be objected that actual carcinomas may have been removed in the course of the biopsy or mastectomy and any subsequently developing cancer might be a mere recurrence. This objection can be largely answered by the gross and microscopic studies of the tissue removed which failed to show carcinoma.

The most difficult problem is to establish a fair norm for the morbidity rate of female breast cancer. Fortunately there has been active interest in the incidence of breast cancer in Massachusetts for years and we believe that the figures for this state are as accurate as now can be obtained.

Although no satisfactory figures exist for breast cancer morbidity rates, we may assume that the annual mortality rate reflects the annual attack rate minus those cases in which patients were cured and those in which diagnosis was never made. We have used this as a basis for our calculations. In order to allow for those patients cured about 20 per cent of all cases seen and those never diagnosed—unknown but probably not large in the breast cancer group, owing to readily available diagnostic facilities and widespread educational efforts in Massachusetts—we have estimated the annual attack rate at twice the death rate.<sup>1</sup>

The age specific death rates for mammary cancer in Massachusetts women in 1930 are shown in Table V. In keeping with other figures (22) the rate is significantly greater for single women,  $78.1 \pm 6.4$  per 100,000 for those single over 30 years of age as against  $55.5 \pm 2.5$  per 100,000 for those not single. The rate for all women over 30 years of age is 59.3 per 100,000. Doubling the death rate for all females (29.7 per 100,000) and for those over 30 years of age (59.3 per 100,000) gives an annual attack or morbidity rate of 0.06 per 100 for the total Massachusetts 1930 female population and a rate of 0.12 per 100 for those women over 30 years of age. While this may be too high, it is well from the standpoint of this study to overestimate rather than underestimate the number of breast cancers occurring in the total female population, as our preliminary data indicated that more breast cancers than usual develop in the chronic mastitis group.

Since some of the women in the group of chronic mastitis—30—and in the group of chronic cystic mastitis—56—had had one breast amputated the expected rate should perhaps be halved for these as they had only

<sup>1</sup>Actually every effort is made to keep the calculations conservative.

TABLE VIII—OCCURRENCE OF CANCER BY AGE AND PRE EXISTING LESION

	Under 30 yrs		30-39 yrs		40-49 yrs		50-59 yrs		60-69 yrs		70-79 yrs		80 yrs. +		Unknown		Total	
	No per sons	No risk years	No per sons	No risk years	No per sons	No risk years	No per sons	No risk years	No per sons	No risk years	No per sons	No risk years	No per sons	No risk years	No per sons	No risk years	No per sons	No risk years
Chronic mastitis—incomplete	6	40	18	178	35	320	42	420	12	162	7	85	1	5	2	23	123	1242
Chronic mastitis—complete	0	0	4	33	7	62	18	185	15	160	2	10	2	17	2	25	50	492
Chronic cystic mastitis—incomplete	3	19	20	134	56	441	77	670	19	210	5	37	2	26	2	11	184	1548
Chronic cystic mastitis—complete	1	6	8	60	33	243	64	551	33	348	13	108	4	56	0	0	156	1372
Adenoma	0	0	0	0	9	100	2	25	3	37	5	50	1	5	1	11	21	228
Adenocystoma	3	25	11	107	15	161	14	160	5	70	3	40	0	0	19	202	70	765
Total of all cases	13	90	61	512	155	1327	217	2020	87	987	35	330	10	109	26	272	604	5647
Number of cancers		0		2		9		8		4		4		2		1		30

half the normal amount of breast tissue in which tumor could develop

That this last assumption is not entirely fair is shown by the occasional finding subsequently in the operative field of normal or pathological breast tissue which may even develop carcinoma after a breast amputation. Consequently the basis of calculation has been left unchanged.

The Massachusetts cases of breast disease studied were divided into two samples, to see whether the trends were similar in each group, and to offset such possible confusing points as variation in popularity of clinics or in types of patients attending different clinics. No significant difference appeared in the two samples, and so they are lumped together in most calculations.

The Massachusetts material when considered in aggregate (sample I and sample II combined) contains 604 cases, in 30, or 2.6 per cent, of which breast cancer developed. The average follow-up period was 9.3 years. There were 173 cases of chronic mastitis with 11 carcinomas, 340 cases of chronic cystic mastitis with 14 carcinomas, 21 cystadenomas with 3 carcinomas, and 70 adenomas with 2 carcinomas. These last two groups are too small to be statistically significant, but are included for the sake of completeness.

The length of follow-up is of great importance. Of the 604 cases, 13 were followed an average of 2.7 years and all these were patients who developed cancer. The other 17

cancer cases were followed an average period of 9.3 years. This is exactly the same as the average period for all cases of breast disease. There is no appreciable variation in length of follow-up with age (Table VI). The longest follow-up period for any case is 21 years. Three per cent, or 17 cases, were followed 19 years and over, and 12 per cent, or 72 cases, were followed 15 years or over.

The age distribution of the cases is important, as disproportionately few cases in the older age groups would materially lower the expected number of cases of cancer. Table VII gives the age distribution of the Boston cases and shows the sample has an adequate number of cases in the later decades (349 over 50 years of age) to have a fair proportion in the so called "cancer age."

The great importance of age of the cases studied is strikingly brought out by Figure 1,

TABLE IX—INCIDENCE OF BREAST CANCER IN CHRONIC MASTITIS AND CHRONIC CYSTIC MASTITIS

(Boston Samples I and II plus Toronto Sample)

	Num-ber of can-cers	Num-ber of indi-vid-uals	Average duration of follow-up years	Num-ber of risk years	Rates (per 100)	
					With risk years adjustment	Without risk years adjustment
Chronic mastitis	14	301	10.0	3014	0.47 ± 0.12	4.65 ± 1.23
Chronic cystic mastitis	21	743	8.6	6379	0.33 ± 0.07	2.83 ± 0.61
Total	35	1044	9.0	9393	0.37 ± 0.06	3.55 ± 0.56

# STATISTICAL SUMMARY

THE BOSTON BREAST CANCER STUDY  
 THE INCIDENCE OF BREAST CANCER  
 IN THE BOSTON POPULATION

TABLE I SUMMARY OF SAMPLE I AND II (COMBINED)	Age Group		Race		Marital Status		Education		Occupation		Religion		Social Class		Total	
	White	Black	White	Black	Married	Single	High School	College	Professional	Non-Professional	Catholic	Protestant	Lower	Upper	Total	Total
1. Number of cases per 100,000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
2. Number of cases per 100,000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
3. Number of cases per 100,000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
4. Number of cases per 100,000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
5. Number of cases per 100,000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6. Number of cases per 100,000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
7. Number of cases per 100,000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
8. Number of cases per 100,000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
9. Number of cases per 100,000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
10. Number of cases per 100,000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

which shows the age specific breast cancer death rates in 3 Massachusetts women over aged 40 for the years 1955 to 1960. This is presented on semi-logarithmic paper in order to keep the scale compact.

Unfortunately we have no way of knowing how many of the women who have developed chronic mastitis and related lesions come under observation. We may assume, however, that a large proportion seek medical aid.

That by no means all cases of breast cancer develop following chronic mastitis is obvious

to anyone treating an approach similar to such lesions. In the case of breast cancer occurring in a given population, however, one can argue in principle that the breast cancer rate is higher in those women who have the chronic mastitis disease and probably in those in the breast cancer rate in the latter group over that of the general population. It would not be a group that be definitely predisposed to development of breast cancer.

In the subsequent tables will be presented the evidence for considering chronic mastitis to be a condition predisposing to the development of breast cancer.

TABLE VI—SAMPLE I AND II (COMBINED)  
 Summary of Boston Cases

TABLE XII—COMPARISON OF OBSERVED NUMBER OF CANCERS OF BREAST IN WOMEN WITH BREAST DISEASE AND EXPECTED NUMBER OF SUCH CANCERS IN NORMAL WOMEN

	Observed	Age adjusted expected		Broad age adjusted expected*		Crude expected†	
		Adjusted for follow up period	Without follow up adjustment	Adjusted for follow up period	Without follow up adjustment	Adjusted for follow up period	Without follow up adjustment
Chronic mastitis Samples I and II							
Incomplete	7	1.6	0.15	1.47	0.15	0.74	0.07
Complete	4	0.8	0.08	0.58	0.06	0.29	0.03
Total	11	2.4	0.23	2.06	0.21	1.03	0.10
Canada total	3			1.52	0.15	0.76	0.08
All groups total	14			3.58	0.36	1.79	0.18
Chronic cystic mastitis Samples I and II							
Incomplete	7	1.8	0.23	1.83	0.22	0.92	0.11
Complete	7	2.4	0.26	1.63	0.18	0.82	0.09
Total	14	4.2	0.49	3.46	0.40	1.74	0.20
Canada total	7			4.10	0.48	2.06	0.24
All groups total	21			7.56	0.88	3.80	0.44
Chronic mastitis and chronic cystic mastitis Samples I and II total	25	6.6	0.72	5.52	0.55	2.50	0.28
All groups total	35			11.14	1.24	5.59	0.60
Adenocystoma Sample I total	3	0.4	0.04	0.27	0.025	0.14	0.01
Canada total	2			0.91	0.08	0.46	0.04
Adenoma Sample I total	2			0.91	0.08	0.45	0.04
All cases Samples I and II total	30			6.70	0.72	3.36	0.36
Canada total	12			6.54	0.71	3.27	0.36
All groups total	42			13.16	1.43	6.63	0.72

\*Broad Age Adjustments based on rate for Massachusetts females over 30 years of age (0011865)

†Crude Expected based on rate for total Massachusetts females regardless of age (0005945)

In this group of 604 cases which might well be assumed to show a lower incidence of breast cancer than the general female population, since that portion of breast tissue noted to be abnormal had been removed, there were 30 cases of cancer developing in a total of 5,647 risk years. It may be objected that the striking number of cancers occurring in this group is due to the inclusion of the 21 cases of adenoma and the 70 cases of adenocystoma. However, only 5 cancers were associated with these—3 with the adenocystomas and 2 with the adenomas.

Among all the chronic mastitis and chronic cystic mastitis cases included in this study, lumping together both the Boston figures and the Toronto figures, one finds 35 cancers occurring in 1,044 individuals, representing a total exposure of 9,393 risk years (Table IX).

This gives the startlingly high 3.35 per 100 as a crude rate, and 0.37 per 100 as a corrected or annual attack rate, taking the follow-up period into consideration. This contrasts with an average<sup>1</sup> mortality rate of 0.029 per 100 which is based on the Massachusetts female population in 1930, or morbidity rate of 0.058 per 100.

When the age specific cancer attack rates per 1000 risk years of the chronic mastitis group are calculated and contrasted (Table X) with those per 1000 risk years of Massachusetts female population two facts stand out. The cancer rate for women with pre-existing breast lesions is 4.5 times as great as for all women, and this predominance is especially marked in the decades below 50 years of age.

<sup>1</sup>Average for 3 years centering on 1930

TABLE XIII—COMPARISON OF FEMALE BREAST CANCER RATES, EXPECTED AND OBSERVED PER 100

	Massachusetts female crude attack rate	Massachusetts age adjusted attack rate (female over 30)	Observed attack rate as shown by adjustment	Expected attack rate as shown by adjustment
Chronic mastitis Samples I and II, Incomplete	06		$30 \pm 21$	$6 \pm 09$
Complete	06		$61 \pm$	$8 \pm 04$
Total	06		$61 \pm 09$	$6 \pm 23 \pm 06$
Canada total	06		$\pm$	$24 \pm 34$
All groups total	06		$42 \pm$	$66 \pm$
Chronic cystic mastitis Samples I and II, Incomplete	06		$45 \pm 17$	$81 \pm 41$
Complete	06		$\pm 09$	$20 \pm 06$
Total	06		$46 \pm 13$	$41 \pm 09$
Canada total	06		$00 \pm 00$	$6 \pm$
All groups total	06		$33 \pm 09$	$\pm 09$
Chronic mastitis and chronic cystic mastitis Samples I and II, total	06		$\pm 13$	$87 \pm 61$
All groups total	06		$37 \pm 06$	$\pm 06$
Adenocarcinoma Sample I total	06	13	$34 \pm 16$	$\pm 61$
Canada total	06		$06 \pm 18$	$24 \pm 67$
Adenoma Sample I total	06		$06 \pm$	$06 \pm 09$
All cases Samples I and II total	06		$\pm 10$	$06 \pm 06$
Canada total	06		$32 \pm 06$	$07 \pm 06$
All groups total	06		$32 \pm 06$	$07 \pm 11$

Thus, in the age group 30 to 49 years, the cancer attack rate per 1000 risk years in the group being studied was  $5.06 \pm 1.80$  as contrasted with a calculated attack rate for the Massachusetts female population of  $0.30 \pm 0.03$  a rate of 11.7 times as great for the women with pre-existing breast lesions as for the Massachusetts female population in the same age group. This preponderance is less striking in the older age groups. In cases over 50 the rate in the study group is slightly less,  $5.23 \pm 1.23$  as contrasted with a considerably greater rate for the Massachusetts female population  $2.1 \pm 0.07$  still giving a preponderance of 2.5 times as high a rate in the group with pre-existing breast lesions as compared with women in general.

Thus, not only is cancer more prevalent in those women who have given evidence of previous breast pathology but in addition this preponderance is particularly marked in the women under 50 years of age at the time when

the breast tissue is more definitely responsive to endocrine influences than in the later years of life. In other words *once a woman who has developed chronic mastitis reaches the menopause her chance of developing breast cancer is not much greater than that of anyone but until that time she is in far greater danger of developing breast cancer than is the woman whose breasts have been apparently normal.*

If we still further subdivide the difference in rate by age groups as is also given in Table X we note that there is a general trend for the discrepancy between the two sets of rates to be higher in the younger age groups and to decrease in the older. However in every age group the rate is higher for the patients with pre-existing breast pathology than the rate for the entire female population, and when all the cases are lumped regardless of age there is 4.5 times as high a rate among the group of cases studied as among the Massachusetts female population.

In order to determine which lesion, if any, presented the greater risk, Table XI was prepared, in which the cases studied are classified by lesions and the rate per 1,000 risk years calculated for each. The rates differ considerably from one another, except in the two types of mastitis, and give some support for the belief held by many pathologists that the adenocystomas are more dangerous than the adenomas, patients in whom the former had occurred having a rate of 13.2 per 1,000, the latter a rate of 2.6 per 1,000.

Still another way of comparing the frequency of the cancer cases in the group studied, as contrasted with the total Massachusetts female population, is a direct comparison of the observed number of cases as contrasted with the expected number. This is presented in Table XII. These are subdivided according to the types of lesions, the sample of the population, and the type of treatment. The observed number of cancers in any given group is contrasted with the expected number of cancers presented in three different ways. First, a specific age adjustment, second, a broad age adjustment for females over 30 years of age, and third, a crude rate without any adjustment for age, based on the total Massachusetts female population. The expected number of cancers were calculated by the following formula. The mortality rate was multiplied by two to give an attack rate, as explained earlier. The rate was then dropped back 2 years as a further correction, since the observed cases of cancer were based on the time of appearance of the cancer and not on the death of the patient, on the assumption that an average duration of untreated breast cancer is 2 years from the time the lesion is diagnosed to death.<sup>1</sup>

It will be noticed that in every age group and in every lesion and in every sample, the observed number of cases materially exceeded the expected. Forty-two cancers were observed as against 13.16 expected in the grand total of all cases. In the Boston samples of chronic cystic mastitis and chronic mastitis 25 cases of cancer occurred, as against 6.6 expected. Thus this method of calculation

substantially agrees with the other in giving a fourfold increased prevalence of breast cancer in those women with antecedent chronic mastitis.

Another way of contrasting the incidence of carcinoma in the total female population and in the chronic mastitis group is presented in Table XIII. The expected cancer attack rate per 100 and the actual attack rate are compared. Here the various population samples and the various types of breast lesions have been considered separately and the cancer attack rate determined for each, then contrasted with both a crude expected attack rate for the total Massachusetts female population and a rate calculated for Massachusetts females over 30 years of age. The crude rate is 0.06 per 100 for the total female population and the adjusted for those of age over 30 is 0.12 per 100. The observed attack rates are calculated with adjustment for follow-up years and without adjustment for follow-up years. Utilizing this method of calculation as well, it is seen that in every sample the observed attack rate is greater than the calculated attack rate, although 100 is 4.5 times as great as the expected attack rate adjusted for the Massachusetts female population of above 30 years of age. This observed rate is significantly greater than the expected.

#### EVALUATION OF STUDY

The foregoing data indicate that women with breast abnormalities of the types considered, particularly chronic mastitis, chronic cystic mastitis, and papillary adenocystoma, show a definite predisposition to the development of breast cancer, especially prior to the menopause. This is despite the fact that the most abnormal or even all the abnormal tissue had been supposedly removed by surgical intervention.

Statistical studies are handicapped from outset by an ignorance of the course of benign lesions of the breast, their cause and incidence in the general female population. But unless a very large proportion of clinically significant mammary pathology is overlooked, the conclusions from this study would not be vitiated. In a careful search of breast tissue at autopsy, it is possible to find small foci of

<sup>1</sup>This should be distinguished from the figure of about 3 years for average duration of symptoms to death.

TABLE VIII—COMPARISON OF FEMALE BREAST CANCER RATES, EXPECTED AND OBSERVED PER 100

	Massachusetts female crude attack rate	Massachusetts age adjusted attack rate (females over 50)	Observed attack rate ± follow-up adjustment	Observed attack rate without follow-up adjustment
Chronic mastitis Samples I and II, Incompletes	06		56 ± 11	1 84 ± 09
Completes	06		±	00 ± 0
Total	06		61 ± 10	23 ± 06
Canada total	06		± 14	34 ± 34
All groups total	06		47 ±	6 ± 13
Chronic cystic mastitis Samples I and II, Incompletes	06		45 ±	81 ± 11
Completes	06		37 ± 10	00 ± 06
Total	06		48 ±	± 07
Canada total	06	1.1	00 ± 06	± 05
All groups total	06		35 ± 07	± 04
Chronic mastitis and chronic cystic mastitis Samples I and II, total	06		54 ±	87 ± 06
All groups total	06		37 ± 06	± 06
Adenocarcinoma Sample I total	06		31 ± 06	1.1 ± 05
Canada total	06		10 ± 08	87 ± 07
Adenoma Sample I total	06		10 ± 09	00 ± 00
All cases Samples I and II total	06	1.3	63 ± 10	00 ± 06
Canada total	06	1.3	00 ± 06	00 ± 06
All groups total	06		30 ± 06	00 ± 01

Thus, in the age group 30 to 49 years, the cancer attack rate per 1000 risk years in the group being studied was  $5.96 \pm 1.80$  as contrasted with a calculated attack rate for the Massachusetts female population of  $0.50 \pm 0.03$  a rate of 11.7 times as great for the women with pre-existing breast lesions as for the Massachusetts female population in the same age group. This preponderance is less striking in the older age groups. In cases over 50 the rate in the study group is slightly less  $5.23 \pm 1.23$  as contrasted with a considerably greater rate for the Massachusetts female population  $2.11 \pm 0.07$  still giving a preponderance of 2.5 times as high a rate in the group with pre-existing breast lesions as compared with women in general.

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If we still further subdivide the difference in rate by age groups, as is also given in Table X, we note that there is a general trend for the discrepancy between the two sets of rates to be higher in the younger age groups and to decrease in the older. However in every age group the rate is higher for the patients with pre-existing breast pathology than the rate for the entire female population and when all the cases are lumped regardless of age there is 4.5 times as high a rate among the group of cases studied as among the Massachusetts female population.

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Still another way of comparing the frequency of the cancer cases in the group studied, as contrasted with the total Massachusetts female population, is a direct comparison of the observed number of cases as contrasted with the expected number. This is presented in Table XII. These are subdivided according to the types of lesions, the sample of the population, and the type of treatment. The observed number of cancers in any given group is contrasted with the expected number of cancers presented in three different ways. First, a specific age adjustment, second, a broad age adjustment for females over 30 years of age, and third, a crude rate without any adjustment for age, based on the total Massachusetts female population. The expected number of cancers were calculated by the following formula. The mortality rate was multiplied by two to give an attack rate, as explained earlier. The rate was then dropped back 2 years as a further correction, since the observed cases of cancer were based on the time of appearance of the cancer and not on the death of the patient, on the assumption that an average duration of untreated breast cancer is 2 years from the time the lesion is diagnosed to death.<sup>1</sup>

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TABLE VIII.—COMPARISON OF FEMALE BREAST CANCER RATES, EXPECTED AND OBSERVED PER 100

	Massachusetts female rate for attack rate	Massachusetts rate adjusted attack rate (relative on or 100)	Observed attack rate with follow up adjustment	Observed attack rate without follow up adjustment
Chronic mastitis samples I and II, incomplete	06		26 ±	64 09
Complete	06		64 ± 11	8 00 0
Total	06		64 ± 10	6 21 06
Canada total	05		± 11	14 ± 11
All groups total	06		47 ±	61 ± 73
Chronic cystic mastitis samples I and II, incomplete	06		43 ± 17	1 ± 41
Complete	06		31 ± 10	00 ± 04
Total	06		06 ±	± 09
Canada total	06		10 ± 00	± 05
All groups total	06		11 ± 07	1 ± 04
Chronic mastitis and chronic cystic mastitis samples I and II, total	06		11 ±	07 ± 01
All groups total	06		17 ± 06	11 ± 10
Adenocarcinoma sample I total	06		11 ± 16	11 ± 04
Canada total	06		06 ± 1	± 02
Adenoma sample I total	06		10 ± 19	10 ± 00
All cases samples I and II total	06		11 ± 10	06 ± 00
Canada total	06		± 06	09 ± 10
All groups total	06		10 ± 06	1 ± 01 ± 17

Thus, in the age group 30 to 49 years, the cancer attack rate per 1000 risk years in the group being studied was  $5.96 \pm 1.80$  as contrasted with a calculated attack rate for the Massachusetts female population of  $0.50 \pm 0.03$  a rate of 11.7 times as great for the women with pre-existing breast lesions as for the Massachusetts female population in the same age group. This preponderance is less striking in the older age groups. In cases over 50 the rate in the study group is slightly less  $5.23 \pm 1.23$ , as contrasted with a considerably greater rate for the Massachusetts female population  $2.11 \pm 0.07$  still giving a preponderance of 2.5 times as high a rate in the group with pre-existing breast lesions as compared with women in general.

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chronic mastitis in a surprisingly high proportion of cases, far higher than could be detected by any method of clinical examination. Such foci might be a starting point for carcinoma, but there is no way to prove or disprove the point. It is to be hoped that a careful study may be made that will give definite information as to the incidence of clinically significant chronic mastitis and chronic cystic mastitis in the general population.

While the findings here presented corroborate those of many earlier workers in establishing a relationship between chronic mastitis and carcinoma (16 17 31 34, 38) they conflict with some recent work, notably the conclusions of Lewis and Geschickter (25). These authors present the incidence of cancer of the breast among 1,048 cases of "adenosis" and cystic disease of which 523 patients were followed 5 years or more. Of the 1,048 381 patients were not operated on but were diagnosed clinically. It was not stated how many of the patients checked by pathological examination were followed. The ages of their patients are not given in the text, but based on the graph they present the average age of their cases is 38 years, an age at which the development of breast cancer is relatively rare. It is not stated whether the graph represents ages at the beginning or end of the follow-up period. The rate of breast cancer they find for the followed cases I calculate as  $0.77 \pm 0.4$  per 100 for the total period or about 0.15 per 100 per year. If the ages of their patients represent the end of the follow-up period the annual death rate for the total Massachusetts female population of the same age is 0.01 per 100 and doubled for a morbidity rate is 0.02 per 100. Thus the incidence of breast cancer in their cases is 7 times the expected. However if the ages of their patients represent the beginning of the follow-up period, a mortality rate for all Massachusetts women of 0.04 per 100 or a morbidity rate of 0.08 would apply. In this instance the incidence of breast cancer among their cases is twice the expected. On either basis of calculation their conclusion that these figures would seem to indicate that cystic disease and adenosis are not precancerous lesions" appears unsupported.

In any evaluation of statistical material

dealing with this subject, it is important to remember the finding of Bigelow and Lombard that the average age of females with breast cancer is 60 years. Therefore, any series of cases in younger women should not be compared with crude breast cancer rates, but with age-specific rates.

If we consider Figure 1 the strikingly increased incidence of cancer of the breast with increasing age becomes apparent. The women in older age groups must have less and less hormonal stimulation of mammary tissue. Therefore it may well be argued that if chronic mastitis and chronic cystic mastitis, which seem to be definitely associated with hormonal disturbances, are important factors in the development of cancer there should be a decrease in the age-specific cancer rate toward the later years of life rather than the increase that is definitely present. That the changes which the breast tissue may undergo in old age are of enormous importance in the etiology of breast cancer no careful observer can deny. That the output of estrogen alone of the female sex hormones continues after the menopause may well be significant.

However the genesis of cancer of the breast is not my immediate problem. I am concerned with the significance of abnormality of the breast tissue as evidenced in chronic mastitis and chronic cystic mastitis in relation to the subsequent development of cancer. It is immaterial in the present discussion that cancer of the breast is much more prevalent at 80 years of age than it is at 40. The point of definite importance is that 4.5 times as many cases of chronic mastitis subsequently developed cancer of the breast age for age, as would be expected for the female population as a whole.

A relationship between chronic mastitis and cancer exists, regardless of the interpretations placed on it. Although cancer of the breast may often arise independent of the lesion, its significance as a precancerous process remains. Merely because a very high proportion of elderly people develop skin cancer we cannot discount the effect of excessive exposure to radiation as a cause of skin cancer. In the rather rough classification possible in this study we have found the actively proliferating lesions such as intraductal papilloma and cysts

with papillary epithelium to be followed by cancer more often than the adenofibromas or large cysts with atrophic lining epithelium

Cystic disease of the breast may lead to grave developments not only in humans but in laboratory animals, as has been so clearly pointed out by Greene in the rabbit, and as the experiments of Bagg in inducing epithelial stimulation and retention of secretion of the mouse breast tissue suggest

One somewhat discouraging finding is that in general no one type of lesion in the human breast can be pointed out as particularly likely or unlikely to be followed by cancer, except the intraductal papilloma on the one hand and adenofibroma on the other. In general, the larger cysts with atrophy of their lining epithelium are less likely to be followed by malignancy than those with active, often papillary, epithelium. In such a cyst, aspiration of the contents may be a justifiable therapeutic procedure, though determination of the exact nature is not easy, and excision is preferable.

The difficulty of accurate diagnosis is well shown by a recent case, that of a woman 32 years of age, who had a small focus of thickening in her breast. This was thought by two competent surgeons to be benign, but on operation an adenocarcinoma, less than 1 centimeter in diameter, with metastasis to 1 axillary lymph node was found.

From the standpoint of this study, what shall we do about a woman who had developed a sufficiently marked degree of chronic mastitis, cystic or otherwise, to be of clinical importance? Hormonal therapy is often effective in the milder cases, and should be tried if the lesion is characteristic of chronic mastitis, cystic or otherwise, and does not suggest carcinoma. It must be remembered, however, that estrogenic hormones stimulate mammary epithelium. If prompt response to hormonal therapy is not obtained, the breast should be operated upon and the nature of the lesion determined. If mastitis is present, in the light of the data here presented, it is impossible not to regard the patient as being subject to special risk of the development of cancer of the breast at some later date, should her mammary tissues be allowed to remain. There are two courses open. One, the more radical (and

the less desirable), is to advise the patient to permit amputation of both breasts, since, when the process has involved one, it may well involve the other. The other alternative is, after removal of the definitely diseased tissue, to have her breasts carefully checked at least every 6 months for evidence of abnormality. This, when encountered, should lead to a simple unilateral mastectomy if the lesion is benign, and radical mastectomy if proved malignant.

Even if not cancerous, breast tissue permitted to remain will probably develop further recurrence of the mastitic process. Not only is the hazard of carcinoma real, but the persistency of the mastitic process most striking. Not even in those cases in which temporization and incomplete surgical procedures have been carried almost to an extreme has there been any guarantee that with the piecemeal removal of pathological mammary tissue the residual tissue should remain free from disease. Thus, of 173 women with chronic mastitis in the Boston sample, 26 or 15 per cent had subsequent trouble with their breasts, and of 320 women with chronic cystic mastitis, 58 or 17 per cent had subsequent breast trouble. This corresponds with the 16 per cent recurrence rate noted by Greenough and Simmons (17). In other words, about 1 woman of 6, even after the most obviously diseased portion of her mammary gland is removed, develops subsequent trouble, ranging from serious discomfort to the requirement of a second operation for relief, and 1 of every 29 develops carcinoma.

If intraductal papilloma or adenocystoma (Figs 2 and 3) is encountered, simple mastectomy should be seriously considered, although the figures in the present study are too few to permit conclusions to be drawn. Other lesions of similar type may be present in the rest of the breast, and the transition to cancer is relatively easily made. At times very careful pathological study is required to determine whether or not the epithelium is invading the surrounding tissue.

Not infrequently the typical picture of chronic cystic mastitis (Fig 4) is complicated by various inflammatory changes. If, in such an event, much retained secretion is present,

foci of lipoid filled phagocytic cells may constitute a prominent part of the picture (Fig. 5). As a rule however inflammatory changes play a minor rôle, and there is no evidence of transition from them to neoplasia. Epithelial hyperplasia (Figs. 6 and 7) is a much more important factor. At times the epithelium lining the cysts is in part or entirely acidophilic, usually high cuboidal or columnar (Fig. 6) and sometimes thrown up in papillary folds. This is similar to the epithelium of the so called sweat-gland carcinoma of the breast (33) which is better considered as originating from the mammary epithelium.

Sometimes the cystic disease is very variable, minimal in some portions (Fig. 8) and very well marked in others. The cysts may be associated with a diffuse proliferation of the acinar tissue, which gives a rather confusing picture (Fig. 9) that may simulate carcinoma.

Whether the cysts be large or small, their epithelium may be hyperplastic—at times extremely so—as in those in which only lack of invasion of the surrounding duct wall prevents a diagnosis of carcinoma (Fig. 10) but more often present to a minor degree. The papillary projections into the cysts may be unradicular but often show multiple points of origin. Different portions of the epithelial lining of the cysts may vary in cell size, shape, and staining reaction. Sometimes the epithelial proliferation forms broad projections, occluding the lumen save where it contains unspiculated secretion. In such regions anaplasia may be marked and definite carcinoma develop (Fig. 11).

Increase in periductal elastic tissue not infrequently occurs in chronic mastitis, but is not of value in determining whether or not carcinoma will develop subsequently. Breasts in which extreme degrees occur as in intra-canicular adenofibroma (Fig. 12) develop breast cancer no more frequently than do all women.

#### SUMMARY AND CONCLUSIONS

1. The development of breast cancer in 1,206 women, whose breasts had been operated upon for benign non-infectious lesions of the breast, was studied and compared with the incidence of breast cancer in females of the

general population in the same age groups. The figures for the Massachusetts female population for the 5 years centering on 1930 were used.

2. The results obtained from the 3 samples studied (2 in Boston and 1 in Toronto) were essentially similar.

3. The results obtained by different methods of statistical analysis are essentially similar.

4. While the data are insufficient with regard to adenoma and adenocystoma, they do indicate that adenoma is without significance as regards subsequent malignancy, and that adenocystoma is a precancerous lesion.

5. Estimates of the occurrence of breast cancer based on crude rates are of little value. Age specific rates are essential.

6. The breast cancer morbidity or attack rate may be estimated as double the mortality rate based on Massachusetts figures.

7. The breast cancer attack rate is 0.12 per 100 for Massachusetts women over 30 years of age but is  $0.47 \pm 0.12$  per 100 for women with chronic mastitis,  $0.33 \pm 0.07$  per 100 for women with chronic cystic mastitis, and  $0.38 \pm 0.06$  for all cases studied.

8. When age specific rates are used, the breast cancer attack rate for women with chronic mastitis and related lesions in the age group from 30 to 49 years is 11.7 times the rate for the Massachusetts female population in the group over 50 years of age, 2.5 times as great in the entire group, 4.5 times as great.

9. Chronic cystic mastitis and chronic mastitis predispose to the development of breast cancer.

10. No means at present exist to determine those lesions which will develop cancer and which will not.

11. The risk is not sufficiently great to warrant bilateral mastectomy in cases of chronic mastitis and chronic cystic mastitis.

12. Patients in whom these lesions are found on operation should subsequently be carefully watched and simple mastectomy done if nodules or cysts develop in residual breast tissue.

13. The figures for incidence of cancer in the group studied although high are none the less minimal for the material and probably

with the further lapse of time additional cases will develop

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# SPILEN EXTRACT IN THE TREATMENT OF TRANSPLANTED AND SPONTANEOUS MALIGNANT TUMORS IN MICE

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**I**N a recent paper (7) one of us (Lewisohn) presented the effect of subcutaneous injections of concentrated beef spleen extract (100 grams in 1 cubic centimeter) upon mouse sarcoma 180. It is well known that this tumor is most resistant to any form of treatment. The fact that a complete disappearance of the tumors resulted in 60 per cent of the animals demonstrated that concentrated spleen extract offered a new approach to a therapy of this very malignant tumor.

Additional observations reported in that paper were (1) Whereas these tumors regressed in response to highly concentrated spleen extract their growth was stimulated by a weak concentration (2) a marked increase in the size of the spleen was noted in animals treated with concentrated spleen extract, while neither animals treated with other organ extracts nor the controls showed an enlargement of the spleen. (3) The spleen extract did not elicit the Schwartzman phenomenon.

The fact that in general abdominal carcinomatosis the spleen is usually free from any metastasis has induced many research workers to study the effect of the spleen on malignant tumors. The literature on this subject is so extensive that it would be impossible to attempt a detailed report of previous publications. Suffice it to say that while retardation of growth in transplanted malignant tumors in animals has been frequently noted, no complete and lasting disappearance of these tumors has heretofore been reported.

Apolant showed over 25 years ago that the resistance of the body against tumor cell transplantation is lessened after splenectomy.

Urban and Schnitzler stated that intracutaneous transplantation of carcinoma or sar-

coma is effective only after the reticulo-endothelial system has been blocked by a preliminary injection of a dye.

Brueda reported that he could grow mouse sarcoma or carcinoma in rats in 80 to 90 per cent of 200 animals after a splenectomy. However he observed that this high percentage of takes could be obtained only during the first 3 weeks following splenectomy. Later other organs for instance the liver adopt the function of the spleen. This observation points toward the close relationship of the different organs constituting the reticulo-endothelial system.

Fischer Wasels reported that he succeeded in causing small tumors to disappear after treatment with spleen extract. However these tumors recurred as soon as the injections were interrupted. This is at variance with our observations that following the treatment with concentrated spleen extract 60 per cent of the tumors (sarcoma 180) not only disappeared but did not recur after the treatment was stopped (observation time of many months).

Sugiara tested the action of aqueous extracts of different organs on mouse sarcoma 180. Spleen extract was found to exert the most destructive action upon the growth capacity of mouse sarcoma 180 while lung and placenta showed the least effect. Immersion of tumor fragments for 120 hours in spleen extract produced complete inhibition of growth.

The inhibitory action of spleen tissue upon tumor growth was recognized as early as 1912 when Oser and Pribram found that transplantable rat sarcoma grew more rapidly in splenectomized animals and that retrogression and cessation of tumor growth could be induced in sarcoma bearing rats by the subcutaneous injection of spleen-pulp.

Braunstein reported that he was under the impression that in cancer the spleen was the

From the Division of Laboratories, Mount Sinai Hospital.  
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September 3, 1939.

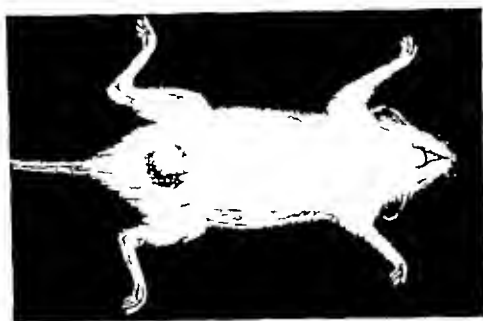


Fig 1 Mouse 123 Treatment started February 18, 1939, healed May 29

main seat for the formation of antibodies. He injected mouse carcinoma into normal mice and splenectomized these animals after 4 to 6 days. The spleens thus removed were used in the treatment of transplanted mouse carcinomas. The spleens were pulverized, dissolved in physiological sodium chloride solution, and injected three to four times daily into the carcinomatous animals. He was impressed by the fact that in animals thus treated the percentage of cures was higher than in the controls.

Biach and Weltmann showed that when a mixture of sarcoma and spleen was inoculated the growth of the tumor was inhibited and that the spleens of sarcoma-bearing rats suppressed the growth much more effectively than those from normal rats.

Mottram and Russ observed that when Jensen's sarcoma was mixed with spleens taken from rats whose tumors had undergone spontaneous regressions, the growth of the sarcoma was delayed.

A few years ago Woglom reported similar interesting experiments. He found that when he mixed fresh tumor emulsion of a rat sarcoma 39 with minced spleen from an immune rat, i.e. a rat in which the tumor had undergone a spontaneous regression, further growth of the tumor cells was markedly inhibited. The inhibition of the growth was proportional to the strength of the spleen emulsion. Thus the inhibition was greater when three parts of immune spleen to one part of tumor rather than equal parts of both constituents were used. These experiments pointed to the presence of a healing factor in the spleen of animals

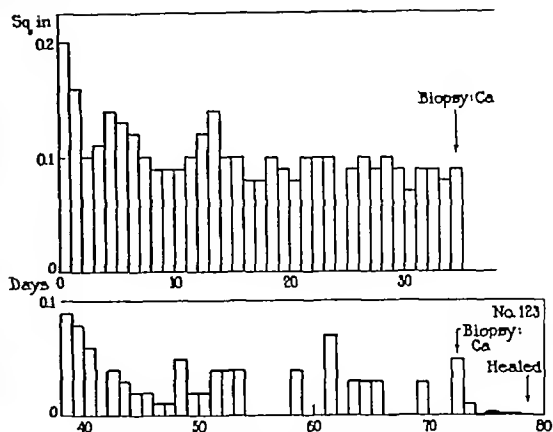


Fig 2 Diagram of mouse 123. Injections of healed spleen extract—33 intravenous and 19 intraperitoneal—were given.

with sarcoma 39 which had undergone spontaneous regression.

In the previous paper (7) results in 281 animals were reported. Of these 170 were healed. These animals were kept for many months in order to see whether they might show recurrences. None was observed after a definite cure had been effected.

The observation of considerable enlargements of the spleens after repeated subcutaneous injections of concentrated spleen extract suggested the idea that these spleens might contain active substances and that it would be of interest to prepare an extract from them.

For brevity's sake this extract will be called "healed spleen extract" in this paper.

Healed spleen extract is prepared in the following manner. The mice were killed with ether. The spleens were immediately removed, weighed, and frozen on blocks of dry ice. The frozen spleens were ground in the mortar with sand. Distilled water and chloroform were added at the following ratio: 5 grams of spleen was mixed with 50 cubic centimeters of water and 5 cubic centimeters of chloroform. The mixture was shaken for about 8 hours in a shaking machine and kept in an ice-box for at least 48 hours. The proteins were precipitated with 10 per cent trichloroacetic acid. The mixture was centrifuged for about 15 minutes at the rate of 3000 revolutions per minute. The supernatant light yellowish fluid was passed through a filter paper and con-



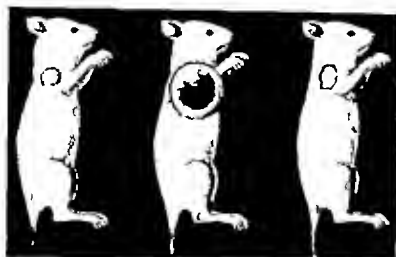


Fig 3 Mouse 32. Treatment started March 26, 1937 healed July

centrated at 60 degrees *in vacuo* until 1 cubic centimeter of the extract represented 1 gram of fresh spleen. The acid extract was neutralized with sodium hydroxide with litmus paper as indicator and filtrated through a Sents filter No 3. Merthiolate (1:200000) was added and the extract was collected in sterile ampoules.

#### ACTION OF HEALED SPLEEN EXTRACT ON SARCOMA 180

The number of injections necessary to effect a cure varied according to the period which



Fig 4 Photomicrograph, mouse 5 shows ag sarcoma strava 1. Several mitoses are evident

had elapsed between the cure of the mice whose spleens were used for the extract and the preparations of healed spleen extract. In the earlier experiments the spleen extract had been obtained from animals which had been cured for 4 or 5 months. When this extract

TABLE I — SARCOMA 180 TREATED WITH INTRA VENOUS INJECTIONS OF HEALED SPLEEN EXTRACT

% of set	Number of mice	Healed	Died with tumors
30	0	8	
5	9	7	
430/437	9	5	4
100	4	7	7
33	7	5	4
	7	7	
	37	30 (81%)	3

TABLE II — CONTROLS. SARCOMA 180

Set percentage	No. of mice	Healed	Died
30-30			
43 (overman)	20		37
11/34			
50	20		9
430-437			
70			11
100		3	7
50			
33 1/3	5		5
5			
	37	3	70

The percentages are per cent



Fig 5 Mouse 134 Treatment started April 6, 1939, healed April 21, 1939

was used, two or three intravenous injections of healed spleen extract were sufficient to effect a cure of sarcoma 180. In our more recent experiments we were forced to use the spleens a few weeks after the cure had been effected, in order to repeat the experiments on a larger scale. In this group of mice, 7 to 8 intravenous injections were needed instead of 2 or 3.

It is possible that the difference in the efficacy of the extract taken from animals cured recently or cured many months ago may be due to the gradual accumulation of "antibodies" in the spleen during a period of months following the disappearance of the tumors. It is well known that the production of antibodies may reach its highest peak after a few months.

Statistical data of the effect of healed spleen extract on sarcoma 180 are given in Tables I and II.

The effect of intravenous injections of healed spleen extract on sarcoma 180 differed very materially from the changes caused in these tumors following subcutaneous injections of concentrated beef spleen extract. The changes caused by the latter extract were described in detail in the previous paper (7). For this reason we shall refer to them here very briefly. In the main, four different stages were observed: (1) hemorrhage, (2) cavity, (3) scab, and (4) cure.

The manifestations of a specific action of the healed spleen extract when used intravenously were entirely different. The growth of the tumor was not inhibited after the first injection, in fact the size of the tumor increased for awhile. However, it stopped growing after a few injections.

The hemorrhage which has been described after beef spleen extract therapy was never

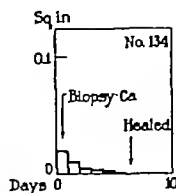


Fig 6 Mouse 134 Five intravenous and 1 intraperitoneal injections of healed spleen extract were given



Fig 7 Mouse 143 Treatment started April 13, 1939, healed April 29, 1939. Died June 5, 1939. Postmortem and microscopic examinations negative for carcinoma.

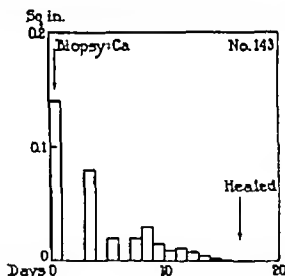


Fig 8 Mouse 143 Twelve intravenous injections of healed spleen extract were given

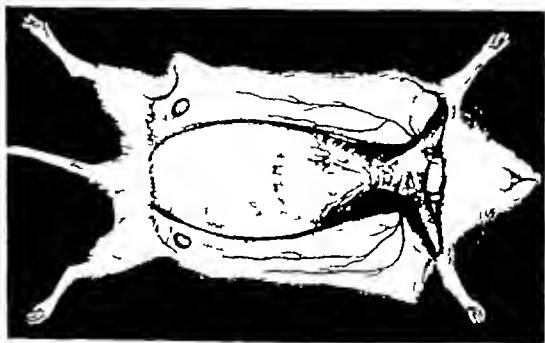


Fig 9 Postmortem findings in mouse 143. Tumor has completely disappeared. Two inflammatory lymph nodes are present.

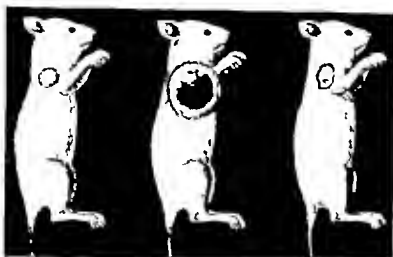


Fig. 3. Mouse 3. Treatment started March 26, 1930, healed July

centrated at 60 degrees *in vacuo* until 1 cubic centimeter of the extract represented 1 gram of fresh spleen. The acid extract was neutralized with sodium hydroxide with litmus paper as indicator and filtrated through a Seitz filter No. 3. Merthiolate (1:200000) was added and the extract was collected in sterile ampoules.

#### ACTION OF HEALED SPLEEN EXTRACT ON SARCOMA 180

The number of injections necessary to effect a cure varied according to the period which

had elapsed between the cure of the mice whose spleens were used for the extract and the preparations of healed spleen extract. In the earlier experiments the spleen extract had been obtained from animals which had been cured for 4 or 5 months. When this extract

TABLE I.—SARCOMA 180 TREATED WITH INTRA-VENOUS INJECTIONS OF HEALED SPLEEN EXTRACT

No. of amp.	Number of mice	Healed	Died (tumors)
30	9	8	
5	9	7	
475	9	5	4
475	4	7	7
500	9	5	4
55	7	7	
	—	—	—
	57	30 (60%)	8

TABLE II.—CONTROLS. SARCOMA 180

No. per amp.	No. of mice	Healed	Died
30/30			
45 (maximum)	30		27
55/34			
50	30		9
425/427			
75			8
500			
80		5	7
5 1/2	8		8
85			
	87	8	79

The regressions were not great



Fig. 4. Photomicrograph, mouse 3 showing adenocarcinoma, strain A. Several mitoses are evident



Fig. 14. Mouse 145. Tumor 1.5 cc. April 15, 1939. Healed May 18, 1939.

fore were satisfied with the results on a relatively small number of experiments. This course was also dictated by the obvious necessity to save the valuable material for the more important experiments with spontaneous mouse tumors.

A comparison of the effect of heated spleen extract with that of concentrated spleen extract shows a higher incidence of cures as well as a distinct shortening of the period of treatment. The superior effect of heated spleen extract might be attributed to the intravenous route of injection which could not be used with the concentrated beef spleen extract because of its thrombosing action. However this is certainly not the deciding factor because heated spleen extract is only 1/100 of the concentration of the beef spleen extract. It might be suggested that the greater efficacy of heated spleen extract is due to a biological concentration and that by combination of the two principles the activity of heated spleen extract may be improved.

Furthermore the difference in the response of the tumors to treatment with heated spleen extract on the one side and with concentrated beef spleen extract on the other side suggests differences in the active principles of both extracts. In the previous experiments with concentrated beef spleen extracts disappear-



Fig. 16. Mouse 157. Treatment started April 28, 1939, healed July 14, 1939.

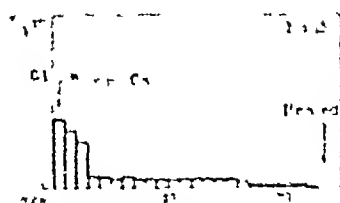


Fig. 15. Mouse 145. Eighteen intravenous injections of purified concentrated beef spleen extract were given.

ance of the tumor was invariably initiated by hemorrhage into the tumor. In contrast heated spleen extract injections effected a disappearance of the tumor without hemorrhage. Hemorrhage is therefore not an essential prerequisite of tumor cure. This observation is paralleled by our experiments with histamine. Sometimes histamine causes hemorrhage into the tumor without a subsequent cure, whereas in other cases a cure is effected without preliminary hemorrhage. In fact of the 25 mice healed by histamine only 11 showed initial hemorrhage. While differences in the action and activity of concentrated beef spleen extract and heated spleen extract are obvious it is most probable that the active principle of both extracts is derived from the spleen as the main reticuloendothelial organ of the body. This conclusion seems justified because

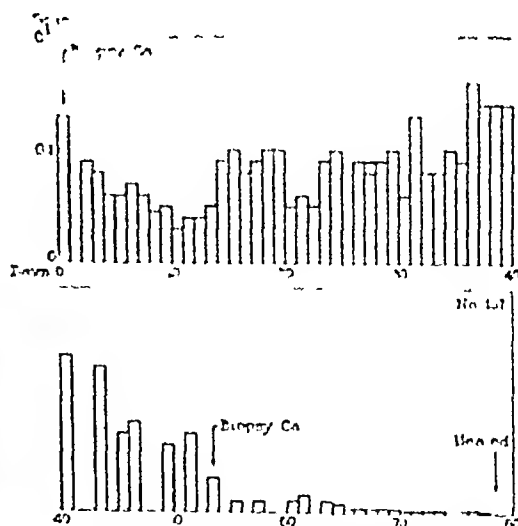


Fig. 17. Mouse 157. There were given 43 intravenous and 3 intraperitoneal injections of purified concentrated spleen extract.



Fig. 2. Mouse 47 Treatment started April 26, 1930  
healed May 9, 1930

observed following the intravenous injection of healed spleen extract. As pointed out (7) this hemorrhage occurs in the majority of the cases a few hours after the first subcutaneous injection of concentrated beef spleen extract. On the other hand following the intravenous use of healed spleen extract the tumor (sarcoma 180) gradually dries up and shows central necrosis. This necrosis differs from the necrosis which is observed in untreated tumors. While the necrosis always stays centrally in the controls and the tumor continues to grow in the periphery in animals treated with healed spleen extract the central necrosis breaks through the encircling tumor resulting in mummification of the entire tumor. A sharp demarcation against the surrounding healthy tissue is noted. Gradually



Fig. 3. Mouse 53 Treatment started April 27, 1930  
healed May 9, 1930

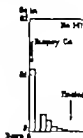


Fig. 4. Mouse 47 Six intra coxae injections of  
healed spleen extract are given

the mummified area is sequestered. The raw aseptic area, which remains exposed after the exclusion of the mummified mass, epithelializes rapidly and leaves no trace of tumor or inflammation.

During this process of restoration the general condition of the mice improves materially. They gain in weight and look like normal and healthy animals. After they are healed the tumor does not recur. We have observed these animals for many months and have never discovered a recurrence.

We then compared the results obtained with healed spleen extract with spleen extracts prepared identically but obtained from untreated normal mice and from normal mice which had been treated previously with 14 subcutaneous injections of concentrated beef spleen extract. These extracts did not influence at all the growth of the tumors (Table III).

In the sarcoma 180 group treated with intravenous injections of healed spleen extract 30 were cured among 57 treated animals (Table I). While the number is limited the results were absolutely uniform and we there-

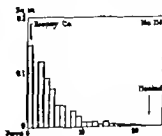


Fig. 5. Mouse 53 Thirteen intra coxae and intra  
peritoneal injections of healed spleen extract are given



Fig 14 Mouse 155 Treatment started April 28, 1939, healed May 18, 1939

fore were satisfied with the results on a relatively small number of experiments. This course was also dictated by the obvious necessity to save the valuable material for the more important experiments with spontaneous mouse tumors.

A comparison of the effect of healed spleen extract with that of concentrated spleen extract shows a higher incidence of cures as well as a distinct shortening of the period of treatment. The superior effect of healed spleen extract might be attributed to the intravenous route of injection which could not be used with the concentrated beef spleen extract because of its thrombosing action. However, this is certainly not the deciding factor because healed spleen extract is only 1/100 of the concentration of the beef spleen extract. It might be suggested that the greater efficacy of healed spleen extract is due to a biological concentration and that by combination of the two principles the activity of healed spleen extract may be improved.

Furthermore the difference in the response of the tumors to treatment with healed spleen extract on the one side and with concentrated beef spleen extract on the other side suggests differences in the active principles of both extracts. In the previous experiments with concentrated beef spleen extracts disappear-



Fig 16 Mouse 157 Treatment started April 28, 1939, healed July 14, 1939

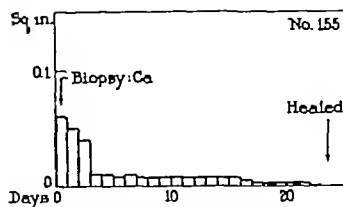


Fig 15 Mouse 155 Eighteen intravenous injections of purified concentrated spleen extract were given

ance of the tumor was invariably initiated by hemorrhage into the tumor. In contrast healed spleen extract injections effected a disappearance of the tumor without hemorrhage. Hemorrhage is therefore not an essential prerequisite of tumor cure. This observation is paralleled by our experiments with histamine. Sometimes histamine causes hemorrhage into the tumor without a subsequent cure, whereas in other cases a cure is effected without preliminary hemorrhage. In fact, of the 25 mice healed by histamine, only 11 showed initial hemorrhage. While differences in the action and activity of concentrated beef spleen extract and healed spleen extract are obvious it is most probable that the active principle of both extracts is derived from the spleen as the main reticulo-endothelial organ of the body. This conclusion seems justified because

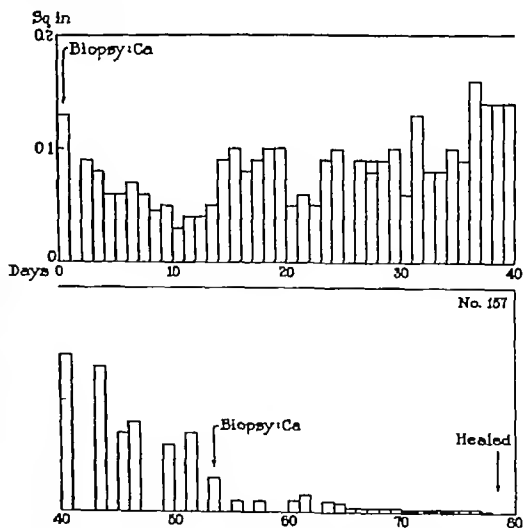


Fig 17 Mouse 157 There were given 43 intravenous and 3 intraperitoneal injections of purified concentrated spleen extract



Fig. 19. Control as of April 1930, at left, and as of July 1930, at right.

of the negative results with the injections of some other organ extracts and the not very impressive percentage of cures with the use of liver extracts from healed mice (Table IV).

The fundamental importance of the spleen as shown in these experiments suggests the attempt to influence spontaneous tumors by transplanting the spleen of healed mice intraperitoneally.

Finally attention must be called to the interesting observation that the only effective spleen extract was that prepared from mice which had been cured of the transplanted tumor by the injection of concentrated beef spleen extract. The spleen of mice with spontaneous regressions does not seem to have any effect on transplanted or spontaneous tumors. In order to obtain successful results from intravenous injections of healed spleen extract in a large percentage of transplanted mouse sarcoma 180 the following sequence is required: (1) growth of sarcoma 180 in mice to moderate size; (2) subcutaneous injections

of 0.5 cubic centimeter of concentrated spleen extract until tumor disappears; an average of 14 injections being required; (3) preparation of extract of spleen according to directions given herein.

Further experiments were made in order to test the effect of histamine and of extracts of organs of healed mice other than spleen. Histamine<sup>1</sup> was injected in single doses of 0.5

<sup>1</sup>Manufactured by Hoffman-La Roche Co.



Fig. 20. Postmortem findings mouse 4. The rest of the malignant tumor. About the same character as the original tumor.



Fig. 21. Mouse 9. Treatment started April 20, 1930, and died July 6, 1930.

TABLE III—SARCOMA 180 TREATED INTRA-  
VENOUSLY (A) WITH SPLEEN EXTRACT  
FROM NORMAL MICE, AND (B) WITH SPLEEN  
EXTRACT FROM MICE WHICH HAD RECEIVED  
14 SUBCUTANEOUS INJECTIONS OF CONCENTRATED SPLEEN EXTRACT

Number of set	Number of mice	Healed	Died with tumors
(a) 238	10	0	10
(b) 239	10	0	10

cubic centimeter of 0.5—1.5 per cent solution. The organ extracts were obtained from the same animals as the spleen extract and prepared in an identical manner as the healed spleen extract. The single dose was also the same. Injections of histamine as well as organ extracts were continued until either the tumors had disappeared or the animals had died. The results of these experiments are summarized in Table IV.

#### ACTION OF DIFFERENT SPLEEN EXTRACTS ON SPONTANEOUS MALIGNANT TUMORS IN MICE (ADENOCARCINOMAS OF THE BREAST)

It seemed of considerable importance to test the action of chemically or biologically concentrated spleen extracts on spontaneous adenocarcinomas in mice. The animals used (strain A) were received from the Jackson Memorial Laboratory in Bar Harbor, Maine. We wish to express our appreciation to Dr C. C. Little and his staff for their splendid co-operation.

When we began to study the effect of spleen extract on spontaneous tumors it soon became evident that the concentrated spleen extract which had given very good results when injected subcutaneously to sarcoma 180 mice, did not cure spontaneous carcinomas. One of the reasons was that, in order to effect a cure, we needed intravenous or intraperitoneal injections, subcutaneous applications of the extract did not act on these tumors. We soon found that we could not use this extract intravenously as it caused (after 2 or 3 injections) a venous thrombosis which made further treatment impossible.

#### PREPARATION OF SPLEEN EXTRACT

We approached this problem from a number of different angles. We used not only

TABLE IV—RESULTS OF TREATMENT IN 398 SARCOMA 180 MICE WITH HISTAMINE AND DIFFERENT EXTRACTS FROM ORGANS OTHER THAN SPLEEN. "HEALED MICE" COMPRISE SARCOMA 180 MICE IN WHICH PREVIOUS SUBCUTANEOUS INJECTIONS OF CONCENTRATED SPLEEN EXTRACT HAD EFFECTED A CURE

Number of mice	Treated with	Route of injection	Healed	Died	Healed per cent
175	Histamine	Subcutaneous	25	150	15
74	Liver extract from healed mice	Intravenous	16	58	21
60	Liver extract from healed mice	Subcutaneous	12	57	17
40	Peritoneum extract from healed mice <sup>1</sup>	Subcutaneous	4	36	10
10	Omentum extract from healed mice	Subcutaneous	0	10	0
10	Thymus extract from healed mice	Subcutaneous	0	10	0
10	Liver extract from spontaneous regressions	Subcutaneous	0	10	0
10	Peritoneum extracts from spontaneous regressions	Subcutaneous	0	10	0

healed spleen extract, but we used a spleen extract from a young bull which had received many subcutaneous tumor transplantations extending over many months. We call this extract (again, for brevity's sake) immune spleen extract<sup>1</sup>. Another extract which was used successfully in the cure of spontaneous tumors was the original concentrated spleen extract which had been purified in this laboratory. This purified concentrated spleen extract does not cause thrombosis of the veins. With this purified extract we were able to give 43 intravenous injections (animal 157). Thirty-three intravenous injections of healed spleen extract were given to animal 123.

We are reporting results with the following spleen extracts: (1) Healed spleen extract (HSE) (1 gm in 1 c cm), (2) immune spleen extract (ISE) (1 gm in 1 c cm), (3) purified concentrated spleen extract (PSE) (100 gm in 1 c cm).

The preparation of healed spleen extract was described in the chapter on transplanted tumors.

<sup>1</sup>We have found recently that Lumsden injected serum of a sheep many times inoculated with sterile suspension of cancer fragments directly into spontaneous cancer of mice. He observed extensive necrosis and a cure in 10 per cent of the animals. The indirect intravenous approach failed to give results.



TABLE V.—REVIEW OF MATERIAL—SPONTANEOUS ADENOCARCINOMA OF BREAST<sup>1</sup>

Number of animals	Treatment	Healed	Reduced in size	Not influenced
35	H S E		14	
14	I S E	5		
13	P S E	7		
Total			21	5
Per cent		30	30	40

<sup>1</sup> Last reading September 1930.

H. S. E., heated spleen extract.

I. S. E., immune spleen extract.

P. S. E., purified concentrated spleen extract.

Immune spleen extract was prepared in the following way. The animal was killed and the spleen was removed immediately. Preparation and preservation of the extract was practically identical with that for heated spleen extract which was given in detail in the first chapter.

Purified concentrated spleen extract was prepared by dialyzing the concentrated spleen extract. These experiments are still in their initial stage.

We have recently modified the preparation of these extracts. With these modified extracts we can give larger doses without causing toxic symptoms. However we feel that before we are ready to standardize the technique and report it in detail we should experiment with these extracts on a larger scale.

In order to avoid any possible misinterpretation in the proper classification of these tumors we have performed a biopsy in every case herein reported. We have included in our series typical adenocarcinomas only. All sections were submitted for diagnosis to our pathologist, Dr. Klempner. Whenever the slightest doubt existed as to the malignant character of the tumor the case was excluded.

#### EXPERIMENTS

We are presenting records of 25 mice which were cured of their malignant tumors (spontaneous adenocarcinomas of the breast) by treatment with spleen extracts. They represent 30 per cent of the treated animals. In another 30 per cent the tumors either had been arrested or they showed a marked diminution in size at the time of death (see for instance animal 148). Thus we were able to influence

and retard tumor growth in 60 per cent of the animals. The 40 per cent of the animals remaining were resistant to treatment. The tumors continued to grow as in the controls.

The comparatively small number of cured animals (25) may be explained in the following manner:

1. The Jackson Memorial Laboratory was not able to send us more than a few animals each week.

2. With our limited laboratory facilities we could not take care of a very large number of spontaneous tumors as the treatment is not only time-consuming but the animals require most careful individual attention.

Of the 25 animals 13 were cured by heated spleen extract, 5 by immune spleen extract and 7 by purified concentrated spleen extract.

The number and method of the injections (intravenous, intraperitoneal or subcutaneous) and the nature of the extract are described with the individual pictures or in the appended case histories. In addition the diagrams give a very clear day by day picture of the influence of the spleen extract on the tumor growth.

The action of the extracts on spontaneous tumors differs from the action of concentrated spleen extract on sarcoma 180, which was described in the previous paper. The initial hemorrhage did not appear and the typical cavities were not observed. After an initial state of edema the tumors in the majority of cases began to shrink gradually without presenting any necrosis.

There seems to be a more or less definite relation between the size of the original tumors and the number of injections necessary to effect a cure. Small tumors may disappear completely after a few injections, whereas larger tumors may require 30 or more injections to obtain this result. Furthermore the response to treatment seems to depend somewhat on the character of the tumor. Hemorrhagic tumors seem to be more resistant than the unchanged tumors.

Spontaneous regressions in proved carcinomas are unknown. Upon inquiry Dr. Little stated that in these sets of mice they had never seen a spontaneous regression of a malignant tumor when proved by biopsy.

Since we have performed biopsies, we have learned to appreciate the great importance of this step, as about 20 per cent of the biopsies proved to be adenomas or borderline cases. Naturally they were excluded from our series though Haaland and others have claimed that they should be included in the group of malignant tumors. Without biopsies these animals would have been included in our material of malignant tumors as palpatory findings were identical with true carcinomas.

The injections were given intravenously or intraperitoneally. The extracts were injected intravenously into the dorsal or ventral vein in the tail of the mouse. The fact that up to 43 intravenous injections were given to one animal is the best proof that we have succeeded in removing most of the irritating substances from the extract.

Whenever we found it impossible to continue intravenous injections, the intraperitoneal approach was employed.

Naturally the dose for intravenous therapy varied somewhat with the nature of the different extracts. Thus the average dose for healed spleen extract was 0.15 cubic centimeter, whereas purified concentrated spleen extract could be given in slightly larger doses.

In the earlier work the injections caused some shock. With the purification of the extracts the severity of the shock has been lessened considerably, so that in many instances it is hardly noticeable (except with modified spleen extract which will require further detoxication).

Though the actual size of these tumors may appear rather small, they would correspond to a human tumor weighing about 150 grams—a tumor of considerable size.

The subcutaneous dose of 0.5 cubic centimeter of spleen extract corresponds to a human dose of 100 cubic centimeters. The intravenous dose of 0.1 cubic centimeter would correspond to a dose of 20 cubic centimeters.

The life expectancy of a mouse is about 2 years as compared with the human life expectancy of about 60 years. The mice begin to show the tumors when they are about 1 year and 3 months old, which corresponds to 40 years in the human. The analogy in the cancer age of the mouse (1 year and 3 months)

TABLE VI — DAYS ELAPSED SINCE SPONTANEOUS MALIGNANT TUMORS WERE HEALED<sup>1</sup>

	Animal no	Healed since	No of days
1	123	May 29 1939	106
5	147	May 19	116
6	153	May 19	116
7	155	May 18	117
8	156	May 31	104
9	157	July 14	50
10	183	July 10	64
11	187	July 4	70
12	192	July 8	66
13	194	July 20	54
14	196	July 26	48
15	198	July 20	54
16	210	July 27	47
17	218	July 27	47
18	199	Aug 7	36
19	207	Aug 7	36
20	231	Aug 3	40
21	224	Aug 7	36
22	228	Aug 14	29
23	238	Aug 25	18
24	232	Sep 10	3
25	234	Sep 10	3

<sup>1</sup> Last reading September 12 1939

<sup>2</sup> Animal 132 died July 10. Postmortem and microscopic examination showed no carcinoma.

<sup>3</sup> Animal 134 died May 20. Postmortem and microscopic examination showed no carcinoma.

<sup>4</sup> Animal 143 died June 5. Postmortem and microscopic examination showed no carcinoma.

and in the human (40 years and more) is of considerable interest.

It is evident from the illustrations that we have succeeded in curing not only small tumors but carcinomas of fairly good size. However, it should be pointed out that at present very large tumors do not respond to the treatment. We hope to overcome this difficulty by further improvements of the extracts.

We have tried to transplant intraperitoneally "healed" spleens (spleens obtained from sarcoma 180 mice which had been cured by treatment with concentrated spleen extract) to mice, bearing spontaneous tumors. However, as other observers had noticed before us the toxicity of these transplants is so great that the mortality is prohibitive. Though in the surviving animals we had some promising

results the numbers were too small to draw any conclusions.

An interesting observation is presented by animal 148 A and B. The moderate size tumor had apparently disappeared after 8 intravenous and intraperitoneal injections of heated spleen extract. Further injections were stopped as palpatory findings failed to show evidence of tumor. When the animal died 6 weeks later a small rest of tumor was observed (animal 148 B). It is very probable that if we had continued intravenous injections for some time after the disappearance of palpatory findings, the postmortem findings would have been completely negative as in animals 132, 143 A and B and 134.

#### BRIEF ABSTRACTS OF CASES OF CURED SPONTANEOUS BREAST ADENOCARCINOMAS IN MICE

**CASE 1** Mouse No. 3 J M L. Biopsy specimen showed carcinoma. Treatment was started February 8, 1930, healed May 20. Thirty-three intravenous and 9 intraperitoneal injections of heated spleen extract were given. Black tumor biopsy specimen was taken (for 34 days). Our first biopsy. Animal was cured in 78 days. There are occasional increases in size (see diagram) probably partly due to slight errors in measuring. (Tumors in the distal half of the body are more difficult to measure than those in the proximal half.) (Figs. 2 and 3)

**CASE 2** Mouse No. 3 J M L. Biopsy specimen showed carcinoma. Treatment was started March 26, 1930 and animal died July. Nineteen intravenous, 6 intraperitoneal, and 8 subcutaneous injections of heated spleen extract were given. Postmortem and microscopic examinations are negative for carcinoma. (Figs. 3 and 4)

**CASE 3** Mouse No. 34 J M L. Biopsy specimen showed carcinoma. Treatment as started April 6, 1930, healed April. Five intravenous and 1 intraperitoneal injection of heated spleen extract were given. Animal died May 10. Postmortem and microscopic examinations were negative for carcinoma. (Figs. 5 and 6)

**CASE 4** Mouse No. 43 A and B J M L. Biopsy specimen showed carcinoma. Treatment was started April 3, 1930, healed April 20. Twelve intravenous injections of heated spleen extract were given (Figs. 7 and 8). Animal died June 5. Microscopic and postmortem examination are negative for carcinoma but the small inflammatory glands are noted (Fig. 9)

**CASE 5** Mouse No. 47 J M L. Biopsy specimen showed carcinoma. Treatment as started April 26, 1930, healed May 10. Sixteen intravenous

injections of heated spleen extract were given (Figs. 1 and 2)

**CASE 6** Mouse No. 53 J M L. Biopsy specimen showed carcinoma. Treatment as started April 27, 1930, healed May 9. Thirteen intravenous and 1 intraperitoneal injections of heated spleen extract were given (Figs. 12 and 13)

**CASE 7** Mouse No. 55 J M L. Biopsy specimen showed carcinoma. Treatment was started April 3, 1930, healed May 8. Eighteen intravenous injections of purified concentrated spleen extract were given (Figs. 4 and 5)

**CASE 8** Mouse No. 56 J M L. Biopsy specimen showed carcinoma. Treatment was started April 23, 1930, healed May 3. Twenty-five intravenous injections of purified concentrated spleen extract were given. A double tumor was present, one of which was cystic mass. Biopsy specimen was taken from the solid tumor only.

**CASE 9** Mouse No. 57 J M L. Biopsy specimen showed carcinoma. Treatment was started April 3, 1930, healed July 4. Forty-three intravenous and 3 intraperitoneal injections of purified concentrated spleen extract were given (Figs. 6 and 7)

**CASE 10** Mouse No. 83 J M L. Biopsy specimen showed carcinoma. Treatment was started June 15, 1930, healed July 10. Two intravenous, intraperitoneal, and 3 subcutaneous injections of immune spleen extract were given. Dorsal tumor

**CASE 11** Mouse No. 87 J M L. Biopsy specimen showed carcinoma. Treatment as started June 19, 1930, healed July 4. Ten intravenous injections of modified heated spleen extract were given.

**CASE 12** Mouse No. 92 J M L. Biopsy specimen showed carcinoma. Treatment as started June 20, 1930, healed July 8. Four intravenous and intraperitoneal injections of immune spleen extract were given.

**CASE 13** Mouse No. 94 J M L. Biopsy specimen showed carcinoma. Treatment as started June 20, 1930, healed July 20. Sixteen intravenous injections of modified immune spleen extract were given. At such time biopsy as taken. This second biopsy taken to ascertain whether small palpatory mass malignant, proved negative. Microscopic examination of this biopsy was negative for carcinoma.

**CASE 14** Mouse No. 96 J M L. Biopsy specimen showed carcinoma. Treatment as started July 8, 1930, healed July 26. Small tumor. Sixteen intravenous injections of modified heated spleen extract were given.

**CASE 15** Mouse No. 98 J M L. Biopsy specimen showed carcinoma. Large black posterior tumor. Treatment as started July 8, 1930, healed July 20. Seven intravenous and intraperitoneal injections of heated spleen extract were given.

**CASE 16** Mouse No. 101 J M L. Biopsy specimen showed carcinoma. Treatment as started July 3, 1930, healed July 7. Five intravenous injections of modified heated spleen extract were given.

CASE 17 Mouse No 218 J M L Biopsy specimen showed carcinoma Treatment was started July 20, 1939, healed July 27 Five intravenous injections of immune spleen extract were given

CASE 18 Mouse No 199 J M L Biopsy specimen showed carcinoma Treatment was started July 8, 1939, healed August 7 Twenty-three intravenous injections of modified healed spleen extract were given A second tumor appeared on July 11, the third day after injection, and disappeared on July 31, the twentieth day after injection Twenty-three intravenous injections of healed spleen extract were given

CASE 19 Mouse No 207 J M L Biopsy specimen showed carcinoma Treatment was started July 12, 1939, healed August 7 Ten intravenous injections of healed spleen extract were given On September 1 a small recurrence was noted Biopsy examination revealed an adenocarcinoma This responded to treatment which consisted of 10 intravenous injections On September 10 a complete disappearance of the recurrent tumor had taken place

CASE 20 Mouse No 231 J M L Biopsy specimen showed carcinoma Treatment was started July 27, 1939, healed August 3 Six intravenous injections of modified spleen extract were given

CASE 21 Mouse No 224 J M L Biopsy specimen showed carcinoma Treatment was started July 27, 1939, healed August 7 Seven intravenous injections of modified immune spleen extract were given

CASE 22 Mouse No 228 J M L Biopsy specimen showed carcinoma Treatment was started July 27, 1939, healed August 15 Twelve intravenous injections of modified healed spleen extract were given

CASE 23 Mouse No 238 J M L Biopsy specimen showed carcinoma Treatment was started August 2, 1939, healed August 25 Fourteen intravenous injections of modified spleen extract were given

CASE 24 Mouse No 232 J M L Biopsy specimen showed carcinoma Treatment was started July 27, 1939, healed September 10 Thirty-five intravenous injections of purified concentrated spleen extract were given

CASE 25<sup>1</sup> Mouse No 234 J M L Biopsy specimen showed carcinoma Treatment was started August 3, 1939, healed September 10 Twenty-four intravenous injections of purified concentrated spleen extract were given

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<sup>1</sup>Correction (January 1 1940) Since the presentation of the paper we have noticed recurrences in 8 mice (Nos 156 183 187 192 196 198 224 231) We feel that these recurrences may be explained by the fact that treatment was discontinued immediately after the tumor had disappeared In view of the scarcity of the supply (especially healed spleen extract) we tried to give as few injections as possible Since we observed these recurrences we have continued to inject the healed animals once or twice a week No further recurrences have occurred since we followed this procedure Animals 123 191 199 207 210 218 228 238 23 and 234 are alive and well today (3½ to 7 months) One healed mouse (No 153) was missed on October 3 In 6 mice (Nos 132 134 143 147 155 157) which have died since they were healed the postmortem and microscopic examination failed to show any sign of carcinoma We have 23 additional healed mice not reported in this paper Thus the total of healed mice amounts to 39 animals

# PELVIC PERITONITIS IN FEMALE INFANTS AND CHILDREN

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In a specialized study of genital pathology in 371 female infants and children considerable opportunity has been offered to observe instances of infection of the intrapelvic genitalia. Out of the entire group 259 patients have presented frank vaginal infections of which 53 per cent were proved positive for gonorrhea, and an additional 33 per cent were considered highly suggestive of a gonorrheal origin. With the potentiality of ascending infection constantly in mind, we have been able to make observations which should be of value in this altogether too obscure field. Nine instances of proved or highly probable pelvic infection have been studied. We will discuss in order (1) Important points of difference in methods of examination in the immature as opposed to the mature female (2) sources and pathways of infection (3) pathology (4) symptoms, signs and diagnosis (5) pertinent data in 9 personal cases.

## IMPORTANT POINTS OF DIFFERENCE IN METHODS OF EXAMINATION OF THE IMMATURE AS OPPOSED TO THE MATURE FEMALE

The importance of precision and the knowledge gained by experience cannot be overestimated. It is essential that the specialist in this field be intimately acquainted with the anatomical and physiological differentials between immature and mature individuals. Failure to appreciate such factors will result in unnecessary pain and fright, and may serve as the nucleus for a later sex fear complex of alarming proportions. Whereas one may easily overemphasize the potentiality of such manipulations in female infants and small girls, the specialist may not ride rough shod into the management of these conditions without the possibility of serious repercussions.

Precision technique relative to the lower genital tract has been described and illus-

trated in another communication.<sup>1</sup> In connection with disease of the intrapelvic genitalia, certain points in relation to vaginal, rectal and abdominal examination should be re-emphasized here.

*Digital vaginal examination* may be accomplished without serious difficulty in a considerable number of girls between the ages of 10 and 14 years. In the interest of thoroughness a careful attempt to conduct such an examination should be made in each instance. If the child becomes alarmed or the distress is too great, immediate recourse should be had to rectal examination. If rectal examination does not yield sufficiently helpful findings vaginal examination should be done under anesthesia. Satisfactory anesthesia for such a purpose presupposes complete relaxation. Ethylene has been found in general the most satisfactory anesthetic for this purpose. The operator must at no time forget that anesthesia does not protect the child from potential harm contingent upon rough manipulation. Particularly in the case of suspected pelvic infection with possible abscess formation should extreme care be used not to traumatize the delicate and more accessible structures of the immature pelvis.

The accompanying schema (Fig. 1) illustrates the different spatial relationships positions and relative sizes of organs in the immature and the mature individual. Whereas the structures may not be more easily or perhaps even as easily identified due to the thickness and lack of perineal differentiation of the pelvic floor in these young patients it must be borne in mind that the examining finger or instrument is relatively considerably longer and larger pelvic structures are very much more accessible to pressure and digital trauma and a large examining finger at full insertion in an immature vagina may offer a serious threat even to normal pelvic genitalia. This

From the Departments of Gynecology and Urology of the University of Oregon Medical School.  
Read before the meeting of the North Pacific Scroptical Association, Victoria, B. C. November 7 and 8, 1930.

<sup>1</sup>Schauffler Goodrich C. Special method of examination and technique of treatment in female infants and children. *Gynecology, Urology and Proctology* (1931).

warning applies to rectal as well as to vaginal manipulation and should carry with it the concept that anesthesia may create a false sense of security on the part of the examiner.

Points which may be elucidated by vaginal or rectal examination or both are roughly as follows (1) a normal or abnormal general habitus, (2) pelvic tenderness and its localization—unanesthetized patient, (3) pelvic masses and their location, (4) cul-de-sac or rectal wall bulging with or without fluctuation (Fig. 2). Naturally the contribution of the abdominal hand to this examination is important.

Reasons why the examining finger in the child or infant may determine less than in the adult are: The pelvic floor in the child is thick, muscular and undifferentiated by the physiological factors or the mechanical effects of childbearing. Structures clearly defined in the adult, such as the anterior or posterior cul-de-sac exist only as small somewhat indefinite indentations at the bottom of the pelvis. Structures to be examined are very much smaller and more closely packed. Thus, while these same structures are more accessible in so far as actual distance is concerned, tissue thickness, muscle, and fascial investments and the diminutive size of these structures create a definite disadvantage in examination of the immature individual.

*Rectal examination* we estimate as perhaps 30 per cent less efficient than vaginal examination in the adult. Whereas rectal examination may be easily and relatively painlessly performed, even in very small infants, there is little to alter this differential in relation to its diagnostic value. Rectal examination, however, will of necessity be more frequently used in children and infants, and the stereognostic education of the index finger is quite as important in this special department as it is elsewhere. The examiner specifically experienced in rectal examinations in female children should be, and is, able to determine more than his untrained contemporary. This factor should be borne clearly in mind in relation to consultation, the pediatrician may be more helpful in such a situation than the general surgeon or even the gynecologist.

*Abdominal examination* should be conducted with more than usual attention to the pa-

tient's reaction. Careless prodding will evoke voluntary spasm as a response either to a tickling reflex or to concern in regard to rough handling. In this connection the old expedient of immersing the child in a hot bath is extremely helpful. The relaxing effect of this procedure is surprising and highly gratifying. It should be used more often than it is.

#### SOURCES AND PATHWAYS OF PELVIC INFECTION

That the source of pelvic infection in immature females is nearly always *via* the genital tract from below is scarcely disputed. Very little reliable case material is available and conclusions must be to a considerable degree speculative. Exceptions, of course, may occur in cases of general sepsis or pyemia. Causative organisms are, in order of frequency, the gonococcus, pneumococcus, colon bacillus, streptococcus, and staphylococcus. Naturally, the genesis of gonorrheal pelvic disease can be consistently ascribed to the ascending route, *via* the mucous membranes. Interestingly enough a fairly high percentage of pelvic infection in these immature individuals is ascribed to the pneumococcus, and even more interesting is the fact that such infection is seldom *via* the blood stream, but nearly always by ascent through the lower genitalia. These deductions, by the way, are not speculative. Careful bacteriological study in several series of cases has established the presence of identical type pneumococci in the vagina and in the infected adnexa. Of course, pneumonia is generally an antecedent condition, yet pneumococcus pelvic peritonitis in female children is not infrequently recorded in the absence of discernible pneumococcus infection elsewhere. It is of particular interest that even when peritonitis from this organism occurs in the presence of pulmonary involvement, the adnexal infection is set up, in most instances, by migration from the lower genitalia. The condition is seldom noted in males.

Streptococcus pelvic peritonitis is an extreme rarity in the immature female—a fact which attests its almost complete dependency upon injury to the continuity of mucous membranes contingent upon pregnancy or abortion. Infection by the colon bacillus is uniformly the result of rupture of an infected appendix.

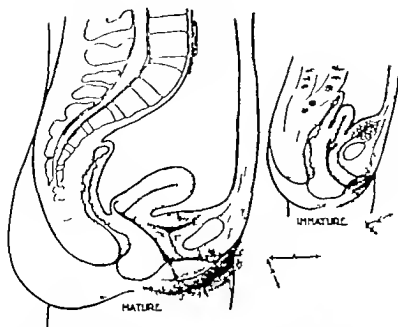


Fig. 3. Schematic of sagittal sections of pelvis of, left, an illiterate adult and, right, year old infant, to differentiate special relationships, size and relations of organs, thick areas of septa (see also Fig. 1). Subtended lines A and B are for comparison. (1) Subtended lines A and B as denoting relative prominence of external genitalia, size of vaginal orifice, protective distance to vaginal orifice, protective pelvic bar. These factors indicate greater accessibility of immature genitalia to causal infection.

or some other primary pathological condition of the bowel (intussusception, etc.) and is secondary. Incidentally the offending appendix need not be pelvic in position to create the clinical picture of a primary pelvic peritonitis. Streptococcus and the even more rare staphylococcus infections have been almost without exception the accompaniments of general sepsis or pyemia. These infections though rare, are extremely severe and have furnished us with most of our postmortem pathological material.

The agency of a primary vaginitis as a focus for dissemination to pelvic structures is of especial interest. In several other communications relating specifically to primary infections of the immature vagina, we have insisted upon the importance of the mechanical conformation of this small organ, with its deep rugae and crypts and have repeatedly pointed to a reversal of roles between the vagina and the endocervix which in its turn is not the complicated racemose gland

riddled structure noted in the adult. The immature cervix, in this instance constitutes a relatively poor harbor of infection due to the late differentiation of its glandular elements (Fig. 3). These basic factors have been repeatedly illustrated and are borne out by the relative frequency of a primary vaginitis in the immature and the relative infrequency of such an entity in the adult. Cervicitis on the other hand is a common entity in the adult and infrequent or virtually negligible in the young. Furthermore endocervicitis when it does occur we have noted only in older children (Fig. 4).

These observations offer a sound explanation for the extremely rare occurrence of upward extension of vaginal infection. The vagina, to be sure harbors the infection but the endocervix and endometrium are not fertile soil for mucous membrane retention or transmission of organisms.

Of our 266 patients with frank vaginal infections only 9 presented symptoms indica

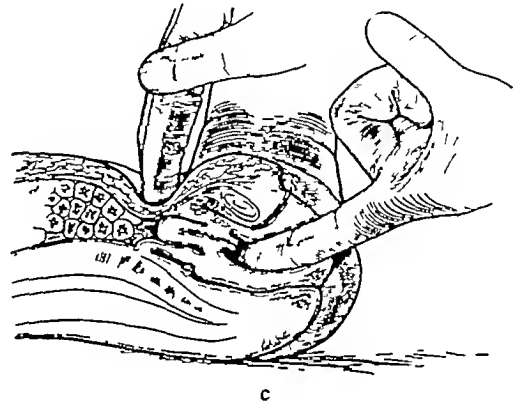
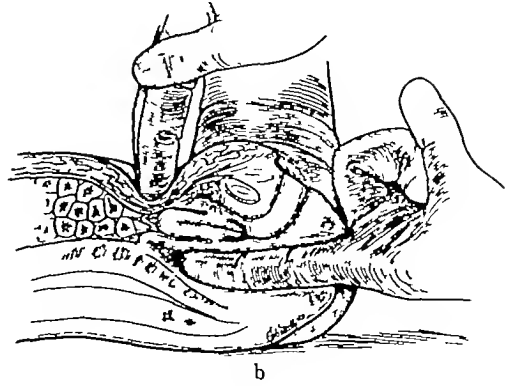
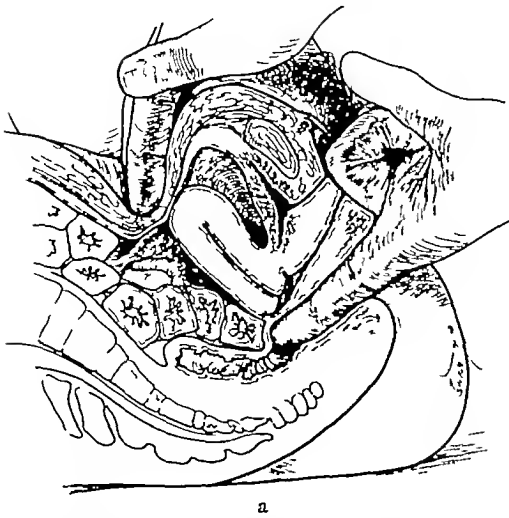


Fig 2 Differential factors in digital pelvic examinations. Figures are drawn to scale. a, Indicates dimensions and special relationships involved in rectal examination of a mature female. Note relative thinness of septa, lack of compactness, and close tactile approach to pelvic viscera and cul-de sac. b, Rectal examination in a 1 year old infant. Note thickness of septa, compact arrangement of viscera—reason for less palpable differentiation of structures in spite of relatively deeper invasion of rectal finger. c, Digital vaginal examination indicates undesirable vaginal distention, thick undifferentiated septa and fasciae—reasons for difficulty in appreciating pelvic pathology in the posterior cul de sac, danger from attempts at a degree of penetration which is harmless in the adult.

tive of pelvic infection (0.034 per cent). In 3 of these the diagnosis was not definitely established. From this and other series, it is clear that the incidence of pelvic infection in immature females with lower genital gonorrhea is only a very small fraction of that noted in adults. Actual figures are available, but not entirely reliable. I regard the likelihood of ascending infection in these patients so lightly that I do not hesitate to tell worried parents that they need have little concern in this connection. Such a statement is eminently justified on the basis of our series, only 3 of our patients being sufficiently ill to warrant serious concern, and all at present are well and apparently functionally competent.

#### PATHOLOGY

Failing a clear concept of the status of immature pelvic viscera such as may be gained only at portmortem or at operation, one will scarcely appreciate what may be expected in

infection of these organs. Outstanding differential factors from the adult are the very small size and lack of intricate differentiation of pelvic organs—uterus, tubes and ovaries, broad ligaments. It is not generally appreciated that the chief growth and adult differentiation of the uterus and endometrium occur very rapidly during a relatively short phase prepuberty and postpuberty. The uterus (Fig 5) remains very small indeed, almost infantile in type, up to a matter of months prior to puberty. The endometrial glands are mere blunt truncated pits (Fig 3). As for the tubes, they are very tiny structures indeed, their mucosa characterized by a much less complicated structure than that noted in the adult (Fig 5). The ovaries also remain small and constitute very poor soil for retention of infection, there being no corpora hemorrhagica or cysts, to serve as harbors. We have, then, as the chief soil for intrapelvic infection, a young and resistant pelvic





Fig. 3. Above, Block sagittal section of uterus and upper vagina at term. Note complicated plicae of vaginal wall, below, simple rudimentary type of cervical glandular structure (see also Fig. 4)

peritonium. Naturally therefore, pathology in this area does not follow adult patterns. Salpingitis *per se* and particularly pyosalpinx and hydrosalpinx, as entities, are noted very seldom indeed, and then only in older children. The characteristic pathological development, and one which it is well to bear in mind in relation to differential diagnosis, follows the pattern of primary peritonitis elsewhere with relatively frequent abscess formation—pointing above being rather more common than in the adult. Characteristic cul-de-sac fluctuation is seldom noted, due to the thickness and rigidity of the pelvic floor contingent upon lack of sexual and puerperal differentiation. In general this pathology assumes, as we have said, the characteristics of peritonitis elsewhere in the abdomen—with fewer of the differential characteristics of progressive inflammatory disease of the adult adnexa.

#### SYMPTOMS SIGNA DIAGNOSIS

In this setting simply to reiterate that the pathological condition in these cases follows the picture of a regional peritonitis should be sufficient. Unfortunately there are no striking differential points. The history of course is of the utmost importance. Vaginal discharge, past or present, particularly if of established gonorrheal origin, is of the greatest diagnostic assistance. I shall however cite an instance

in which such a history seriously confused the true issue and was almost responsible for loss of life. Pneumonia past or present accompanied by lower abdominal symptoms should be regarded with suspicion. A history suggestive of past or present appendicitis infection must be regarded seriously. The agency of severe injury from below—simple trauma or rape—should be obvious in such a setting. Severe pyelitis especially with cystitis may give a very confusing picture since it frequently follows vaginal infection in a very deceptive sequence. Its rather definite characteristics, however together with the urinary findings, should serve to differentiate it or clarify it.

Temperature and white blood counts are as would be expected, elevated beyond the usual adult recordings. We have observed the sedimentation rate in several of our cases, and note in keeping with the general picture less distinction between upper and lower abdominal conditions than in the adult female. This is perhaps due to the simpler and less vascularized condition of the immature pelvic genitalia. Sedimentation rate then is less helpful than in the adult in differentiating pelvic infections from other peritoneal involvements.

Because pelvic infection in the immature female is for the most part simple peritonitis, and because it does not cause the specific symptoms and signs attendant upon adult differentiation of pelvic structures, its differential diagnosis is much more difficult. On the other hand such a differential virtually excludes certain confusing conditions which appear only in the adult, such as ectopic pregnancy, twisted pedicle or ruptured ovarian cyst, strangulated fibroid and the like. Correct diagnosis as a rule at once establishes the presence of pelvic peritonitis. The question then arises as to its origin and its prognosis. If it can be shown by proof or sound inference to be of gonorrheal or pneumococcal origin its management is conservative. If on the other hand it evolves from an infected appendix, it should in most instances be operable. The truly critical differential in this field is between primary pelvic peritonitis, demanding conservatism and pelvic inflammation secondary



Fig 4 Sagittal sections of immature uteri indicating relative simplicity of cervical glandular structure in children, complexity increasing with age a, Two year old child—cervix runs from I internal os to EO external os, b, fourth year, c, ninth year, glands growing deeper, "uterus all cervix", d, fifteenth year, not yet menstruating, thick lining of canal in c and d (From Dickenson's *Human Sex Anatomy*, courtesy Williams and Wilkins, Baltimore)

to an infected appendix, demanding early operation *The very much higher incidence of appendicitis over pelvic infection in female children should be an important immediate consideration*

Granted that a decision is difficult or impossible, the question between operative or conservative management should depend entirely upon the child's condition Laparotomy

for a suspected appendix such as was done upon one of our patients, even if in error, may be less harmful to the patient than failure to operate in the presence of a progressing appendix infection On the other hand radical surgical interference in a belly which is at grips with a long ruptured appendix in a patient already seriously jeopardized, may be a grave error



Fig. 5. Comparison of sizes of uterus and adnexa in, a, stillborn infant, term (seen hooked dorsad); b, mature adult. The importance of actual sizes of organs in relation both to diagnosis and pathology is indicated.

Drainage will occasionally be called for and as I have pointed out will more often be done abdominally than vaginally since for reasons indicated pelvic abscess in the child less often points vaginally. In one of our patients abdominal drainage in the right lower quadrant constituted a life-saving measure. No hesitation should be felt in draining an available abscess through the rectum. This is frequently a very much more desirable procedure than clumsy attempts to invade a tiny cul-de-sac. Finally the resilience and recuperative powers of youth plus intelligent conservatism and supportive measures may be heavily counted upon. Sulfanilamide has been employed in 2 of our cases, both gonorrheal but we do not feel qualified to evaluate the results from this meager experience. The ability of children to withstand heavy concentrations of this drug should point to an excellent future for it in this condition.

Incident to operation upon infants and small children it is hardly necessary to call attention to certain factors of the utmost importance. It is difficult for the general surgeon who seldom operates upon these tiny patients to appreciate the differential involved for example in blood loss. Brunkow estimates that the loss of an ounce of blood in an 8 pound infant is equivalent to the loss of 18 ounces of blood in the robust adult. The strictest attention to hemostasis is therefore demanded. Heat and fluid loss from body surface appears

to be very much more important in these little patients, the relative amount of body surface being very much greater. These and other factors assume critical importance due simply to geometric proportions. Here again specialized experience and meticulous technique may offer tremendous added safeguards. It is not to be denied that the surgeon's experience and skill in pediatric surgery may often constitute the differential factor between success and failure.

#### AUTHOR'S MATERIAL

For our own case material there is little point to a detailed presentation. We have seen 9 children in whom the diagnosis of primary pelvic peritonitis was made. The youngest was 3, the oldest 14 years of age. Three of the diagnoses were not clearly established, 4 were definite, 2 were highly suggestive. Six were frankly gonorrheal. Our most serious case in 1 of the patients who came to operation was proved non-gonorrheal. One child developed a severe pelvic inflammatory reaction while under treatment by hypodermic theelin. Another had a quite typical pelvic flare up in the presence of a gonorrheal vaginitis following a rectal injection of an anti-septic for associated gonorrheal proctitis. Three of these patients could at no time be demonstrated to be infected with gonorrhea. Two patients were suspected of having mild pneumococcal peritonitis, but

were not bacteriologically studied Two were operated upon

Two cases should be briefly described as pointing a moral

#### CASE REPORTS

CASE 1 A small girl, aged 7 years, was operated upon for suspected appendicitis (by the surgical service) Only peri-appendicitis was present Pelvic structures were visibly congested There was considerable free fluid in the cul de-sac and the picture was much more suggestive of a mild pelvic inflammatory reaction A frank vaginitis with positive smears for gonorrhea was demonstrated *after* operation Recovery was uneventful

CASE 2 A child, aged 12 years, who had been treated in my special clinic for gonorrheal vaginitis several years before, entered the surgical service with a textbook history of acute appendicitis There were no symptoms of vaginitis and smears were negative on admission However, the surgical aspect of the case was neglected and the child was treated conservatively for a suspected pelvic inflammatory condition An abscess developed in the right lower abdomen and pelvis which was later drained of large amounts of colon bacillus pus through a small right rectus incision This child very nearly died The surgical service at the present time is inclined to agree with us that infection with rupture of the appendix was overlooked because of a past history of gonorrheal vaginitis

These 2 cases appear to justify the conclusions which we have already formulated, namely With the patient in good condition, less harm may be done by a mistaken operation for suspected appendicitis than by deferring operation under a mistaken diagnosis of primary gonorrheal pelvic inflammation It should be borne in mind that appendicitis in children is common, primary pelvic infection very uncommon indeed

#### SUMMARY

1 Data from the records of 371 instances of female genital pathology in children and infants have been sifted for material in relation to primary pelvic infection In 259 cases the original condition centered about a frank vaginal infection, the majority gonorrheal

2 Important points of difference in methods of examination of the immature as opposed to the mature female are considered Vaginal, rectal, and abdominal examinations are discussed in detail

3 Sources of pelvic infection are considered By far the most frequent route is thought to be by ascent from an infected vaginal tract The gonococcus and the pneumococcus, the organisms most frequently involved, invade almost always in this manner Secondary infection from the appendix is not infrequent, and is always serious

4 Lack of adult and puerperal differentiation accounts for a tendency toward simple peritonitis, the ordinary sequence of involvements in the adult being rarely noted The pathology is essentially that of pelvic peritonitis

5 Differential diagnosis is briefly considered Appendix infections and pvelocystitis are the most frequent confusing factors

6 The very much higher incidence of appendicitis over primary pelvic infections in female children is a most important immediate consideration The decision relative to operation is frequently crucial

7 Pertinent data from 9 personal observations of actual or highly suggestive primary pelvic infection are reviewed

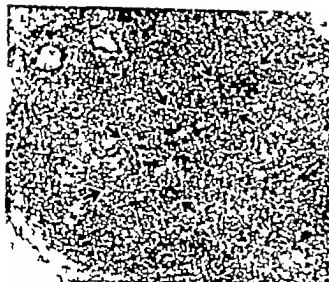


Fig. 3 Granulation tissue from tuberculous anal fistula. In the background of young fibroblasts and capillaries long ovoid tubercle (indicated by arrow) is seen with Langhans giant cell on its border.  $\times 85$ .

Fig. 4 Same tubercle as in Figure 3. Giant cell shows peripheral arrangement of nuclei in foreign-body formation. Epithelioid cells, many lymphocytes, and occasional plasma cells and polymorphonuclear leukocytes.  $\times 500$ .



Fig. 3 Granulation tissue from another tuberculous anal fistula. A small tubercle consisting largely of "epithelioid" and other mononuclear cells and an atypical giant cell at its center. Many empty capillaries are seen.  $\times 175$ .

Fig. 4 Same tubercle as in Figure 3. Epithelioid cells large and very distinct. A discrete dense collection of such cells in round or oval arrangement is strongly presumptive of tubercle formation. The typical giant cell is almost pathognomonic of such specimens. Search of almost in vainly reveal other more typical cells.  $\times 500$ .

# TUBERCULOUS ANAL ABSCESS AND FISTULA CRITERIA FOR DIAGNOSIS

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**A** MORE general agreement on the criteria for diagnosis of tuberculous anal fistula is necessary. What is a tuberculous anal fistula, or when is an anal fistula tuberculous? This question merits an exact answer, not only for the patient's sake but also if reported statistics are to be of value, informed opinion as to the criteria should be in agreement.

It is a well known and, we believe, a generally accepted fact that a clinical diagnosis founded only on the gross pathology is absolutely undependable even though the opinion is that of one thoroughly conversant with the lesion. Not so well known and accepted is the real value of histopathological examination of suspected tissue and the limited reliability of guinea-pig inoculation with preparations of tissue excised from the fistulous tract or abscess cavity wall.

The proponents of guinea-pig inoculation as the most valuable means of making a diagnosis of tuberculosis in peri-anal inflammatory and suppurative disease, particularly abscess and fistula, in most instances accept their findings at face value. The fact is there is a large element of error here which is either unknown or overlooked.

In a study of 200 patients with pulmonary tuberculosis which we recently reported<sup>1</sup> it was determined that in 30 per cent there are not only viable but virulent tubercle bacilli present in the lower sigmoid and rectum. In patients having anorectal abscess or fistula 34 per cent had such tubercle bacilli present in the last foot of the bowel within an hour after an enema.

Thus in a third of the cases tubercle bacilli could enter the rectal or anal orifice (the internal opening) of the fistulous tract. So whether the fistula was a tuberculous process or not, tubercle bacilli might be present in it in

a third of the cases. This large margin of possible error is not considered in any article in the current literature on the subject. One reason for this is that so little work had previously been done to determine the incidence of viable tubercle bacilli in the terminal bowel.

It is absolutely impossible to wash or treat tissue excised or curetted from these fistulous tracts in any way known to bacteriologists so that a contamination from viable tubercle bacilli can be positively excluded. Excluding contamination of tissue by the tubercle bacilli in these cases is just as difficult as really sterilizing the skin of the hands. It follows that the use of cultural or inoculation methods to determine the character of a fistula in patients with an active pulmonary tuberculosis is rather fruitless as the findings must be qualified by a 30 per cent possibility of error. After positive culture or guinea pig inoculation of tissue from the fistula the pathologist can accurately only state "The culture or guinea pig test is positive but it may be wrong as far as determining whether this is a tuberculous fistula or not in at least a third of the cases."

The chief difficulty arises in knowing what to call tuberculous granulation tissue. There is little question about the tissue with capillaries, fibroblasts, monocytes and typical horse-shoe-shaped Langhans' giant cells. When the tissue is atypical there arises the most difficulty. Upon analysis, however, it is not the problem it may seem. In the first place, most non-specific abscesses are composed of acute inflammatory tissue which may be eliminated promptly. The tissue of a chronic or subacute nature may or may not have tuberculous granulation tissue. In such borderline cases the clinical appearance of the lesions, the clinical history, and the bacteriological findings will help to supplement any questionable lesions.

In Figure 1 is shown chronic granulation tissue with a predominance of monocytic cells

<sup>1</sup>From the City of Chicago Municipal Tuberculosis Sanitarium.  
<sup>1</sup>Martin C. L. and Sweany H. C. Etiology of tuberculous anal abscess and fistula. *Am J Digest Dis & Nutr* 1940 7:36-39.

containing atypical giant cells but about which there need be little question of a diagnosis.

In Figure 2 there is also chronic granulation tissue and a focal necrosis with a predominance of monocyctic cells, some of which are becoming arranged into atypical giant cells of 4 to 8 nuclei. They are definitely not due to any false arrangement of cells of the rectal mucosa which may at times be confusing. The diseases of the rectum other than tuberculosis that may cause such a stimulation of the monocyctic cells are few and largely hypothetical. It is granted that a tuberculoid condition may exist of the same nature of sarcoid lesions of the skin although none has as yet been described. At the most, they would be too few to cause any distortion of the figures. The diagnosis therefore could safely be called a presumptive one until all the other data are correlated or still better until staining of all the other sections and another search is made for more typical tissue. In our experience when such a study is made all but an insignificant minority fall definitely into one or the other group by the time one half of the sections are examined.

#### SUMMARY AND CONCLUSIONS

The ultimate opinion concerning the nature of fistulous lesions of the anal region therefore will be influenced by various factors

1. Clinical history and appearance of the lesion

2. Clinical history of an active or quiescent tuberculosis or evidence of such by x ray or laboratory examination

3. The presence or absence of viable tubercle bacilli in the excised lesions demonstrated by culture or animal inoculation but here the positive findings are subject to a 30 per cent error in positive sputum cases.

4. The most important and the only pathognomonic test when positive is the finding of tuberculous granulation tissue by histopathological study.

On a single section this is only positive in about 50 per cent of cases, but when run in serial section is at least 75 per cent efficient. Staining only every third section is usually all that is necessary and even staining every tenth gives good results.

The absolute figures depend upon the number of the remaining 25 per cent that are non-tuberculous. If the animal or cultures are positive and the sputum is negative such cases may be added to those found by histopathological examinations. If the specimens come from a positive tuberculous patient the probability is that it is tuberculous, but in the absence of the criteria above mentioned the lesions must be accepted as non-tuberculous or held in doubt until proved otherwise by the proper methods.

# DYSGERMINOMA OF THE TESTICLE

## A Clinical and Pathological Study of 30 Cases

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THE term "dysgerminoma" has been given to a group of tumors of the testicle which heretofore have been described as "seminoma" (Chevassu), "embryonal cell carcinoma" (Ewing), "germinal cell carcinoma" and "spermatocytoma" (Bell), and "round cell sarcoma" (McDonald).

In 1930, Robert Meyer, while investigating a group of testicular tumors, noticed their resemblance to the dysgerminoma of the ovary and because of this similarity he suggested the term "dysgerminoma" since he believed that these tumors originated from undifferentiated germ cells that are found in the gonads before sex differentiation occurs. Hinman and Ewing in this country and Bell in England are all in accord in the classification of the dysgerminomas as a type of a malignant teratoma in spite of the fact that only one type of cell may exist, as demonstrated in the dysgerminoma. The explanation offered is that due to the rapid growth of the type cell an overgrowth and suppression of the other elements occurs.

The tumors under discussion are malignant, often vary from the size of a walnut to that of a grapefruit, and histologically reveal large round or polyhedral cells with hyperchromatic oval to round nuclei and an ample cytoplasm. Hemorrhage and necrosis are frequently present.

In view of the diversity of opinion among various authorities as to the classification of this type of tumor, the term "dysgerminoma" as suggested by Robert Meyer may be an appropriate one.

As to the origin of these tumors, various authorities are fairly unanimous in their opinion that they are derived from the embryonic cells, while others such as Chevassu and Bell hold to the concept that the cells lining the

seminiferous tubules give origin to these tumors. However, Robert Meyer believes that the cells are not derived from the tubules but rather invade them. Ewing is of the opinion that the tumor resembles or duplicates the epithelial cells of the spermatatic tubules, i.e., the spermatocytes. Until the present time a suitable terminology has been found wanting, and therefore we believe the term "dysgerminoma" is descriptive of and applicable to this type of testicular neoplasm which in our study comprised over 95 per cent of all tumors of the testicle.

Our study consisted of a review of 30 malignant neoplasms of the testicle classified as "dysgerminoma." Of this group 12 patients came to autopsy (in a series of 12,000 consecutive necropsies from 1929 to 1939), and 18 patients were operated upon.

Twenty-seven of the patients were white and 3 were colored, as to age, 1 was between 10 and 20 years of age, 4 between 21 and 30,



Fig 1 Photograph of a dysgerminoma of the testicle. Left, Surface of tumor with intact capsule traversed by dilated and congested blood vessels. Right, section surface of the tumor. Note that the entire testicle has been transformed into a homogeneous firm tumor tissue.

From the Department of Pathology, Cook County Hospital and the Division of Surgery, Northwestern University Medical School, Chicago.





Fig. 1 Photomicrograph shows large and multinucleated cells and scanty stroma.

11 between 31 and 40, 6 between 41 and 50, 6 between 51 and 60, and 2 between 61 and 70. The third decade of life had the highest incidence, that is, 36.8 per cent.

The left and right sides were equally affected. Trauma to the testes preceding the onset of the tumor was admitted by 11 patients, or 36.8 per cent. The injury was in the form of either a blow, kick, or fall and occurred from 1 month to 15 years prior to the onset of a visible enlargement of the testicle.

Twenty-three or 76.6 per cent of the patients presented swellings, which varied in size from a walnut to that of a grapefruit.

Loss of weight varied from 20 to 35 pounds in 10 of the patients, or 33.3 per cent, while 9 patients or 30 per cent admitted suffering pain. The pain usually was described as moderate, while in the fatal cases lumbar pain was a frequent complaint.

As to the duration of symptoms in the 18 patients operated upon there were 10 between 2 and 6 months, 3 of 12 months, 3 of 24 months, of 36 months, and 1 patient had



Fig. 2 Dysgermoma of the diffuse type. Cells are interrupted by narrow strands of connective tissue. T is infiltrated with small round cells. Nests, tubercle-like nodules, a, fibrocentral necrosis.

noticed a swelling of the testicle for 6 years. In the 12 fatal cases, 7 came to operation and the survival period following the orchidectomy for the tumor varied from 1 1/2 to 48 months.

An accurate clinical diagnosis of the tumor was made in 18 cases, or 60 per cent; the most frequent error in the diagnosis was hydrocele or tuberculosis.

#### SUMMARY OF THE PATHOLOGICAL FINDINGS IN 30 CASES

Grossly, the tumors varied in size from a walnut to a grapefruit (Fig. 1); were moderately firm in consistency, encapsulated, and on section were composed of a homogeneous grayish white tissue frequently mottled with purplish red areas of hemorrhage.

Histologically, the tumors revealed large polygonal cells often bordering one upon another with a scanty stroma. The cells were composed of an ample cytoplasm and contained large round to oval hyperchromatic nuclei. Nucleoli were often present and atypical mitotic figures were frequently seen. In some the nuclei were very large, irregular, and often multinucleated (Fig. 2).

In 20 of the patients evidences of hemorrhage were noted in 25 necroses. Five of the



Fig 4 Photomicrograph to show 2 types of the pseudopapillary form of dysgerminoma of the testicle

latter revealed a caseation type of necrosis frequently forming circumscribed areas simulating tubercles. However, Langhans' giant cells were not observed (Fig 3). In the fatal group of 12 patients no evidences of active tuberculosis were found at necropsy.

The cells comprising the tumor were arranged in a diffuse pattern in 20 patients, solid alveolar formation in 6, and a pseudopapillary type in 4. Of the latter 4 (Fig 4), although the pseudopapillary arrangement of the cells was predominating, there were other areas in the same section which showed the diffuse type of arrangement of cells as was observed in the majority of the cases. The pseudopapillary type may be thus considered as a mixed form of a more highly differentiated type of dysgerminoma.

The stroma of the tumor was composed for the most part of narrow strands of connective tissue and accumulations of small lymphocytes, the latter varying in number, some of the tumors showing only scattered cells while in others the lymphocytes formed groups.

In the 12 cases that came to necropsy the opposite testicle revealed metastasis in only 1 instance, and in the remainder an interstitial

fibrosis varied from a minimal to marked amount. The degree of spermatogenesis in the uninvolved testicle of the series varied, some showing normal activity while in others it was absent. The lymph nodes were involved in 10 cases and the distribution was as follows: peri-aortic, 10 times, mediastinal, 4, iliac, 3, peribronchial, 3, peripancreatic, 1.

Other sites involved in the metastasis were lungs, 8 times, liver, 5, spleen, 1, right adrenal, 1, brain, 1, kidney, 1, pericardial sac, 1, diaphragm, 1, and spine, 1.

Thrombosis in the fatal cases was observed 5 times, or 41.6 per cent, and was found in the iliac veins and its tributaries.

#### NOMENCLATURE AND OTHER FEATURES

Although the term "dysgerminoma" for the ovary has been widely accepted both by pathologists and gynecologists, this has not been so with "dysgerminoma of the testicle." This may be explained by the fact that the terminology and the classification of tumors of the testicle is in quite a chaotic condition at the present time. It is not the purpose of this paper to propose a new nomenclature for testicular tumors, but up until the present

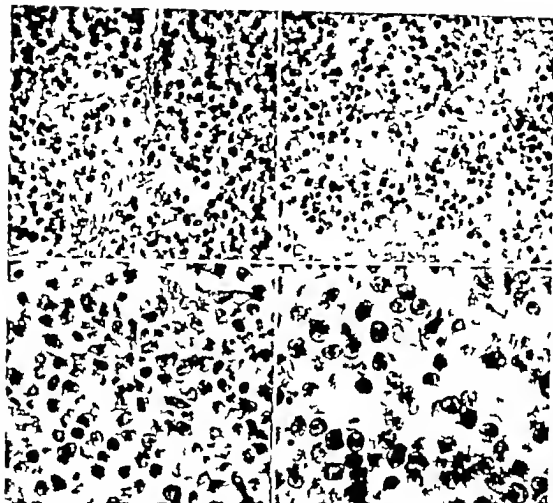


Fig. 5. Photomicrograph of dysgerminoma of the testicle left, low power and high power. Note similarity to

dysgerminoma of the ovary right, low power and high power.

time a tumor of the testis has been called by any of 6 different terms. If tumors are to be classified on a morphological basis then the term "dysgerminoma" is fitting.

Although dysgerminoma of the testicle and the ovary simulate each other histologically (Fig. 5) clinically these 2 tumors differ in that the former is highly malignant and at necropsy metastases are extensive whereas dysgerminoma of the ovary frequently manifests itself by its benign course. However in 53 reported cases of the latter Doederlein found that 14 or about 25 per cent, had extrapelvic

metastases and that 10 of these had run a fatal course. Novak states while dysgerminoma of the ovary is undoubtedly a malignant tumor there are marked variations in the degree of malignancy of individual tumors. The outlook is very favorable when the tumor is unilateral with an intact capsule.

Non-descent of the testicle is often mentioned as a factor in predisposing to tumor development but in our series not one of the tumors was associated with a previous non-descent of the testicle although, in one case the opposite normal testicle was undescended.

## SUMMARY

The results of a pathological study of 30 cases of malignant tumors of the testicle are given, twenty six of the cases were classified as dysgerminoma, while histologically 4 of the cases showed a mixed character. However, there were areas typical of dysgerminoma in the latter group and they may be considered as an intermediate stage of a more highly differentiated type of dysgerminoma.

The term "dysgerminoma" appears to be suitable in describing a distinct group of malignant tumors of the testicle or ovary, which heretofore have been known by a variety of terms, i.e., seminoma, spermatocytoma, embryonal cell carcinoma, etc., thus obviating much of the confusion that exists at the

present time in the classification of testicular tumors

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# TREATMENT OF PATENT URACHUS

## With Report of Seven Cases

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THE patent urachus is a condition which has been known to recorded medical literature since the time of Cabrol in 1550. No doubt patients with this affliction were seen prior to that time and the condition probably was recognized but the cases were not recorded. This first case occurred in a female age 18 in whom there was obliteration of the urethral meatus associated with an umbilical tumor and fistula. The normal flow of urine was re-established the umbilicus sutured and the patient recovered.

Interest in the subject of patent urachus seemed to lag during the seventeenth century as no cases were reported. However during the eighteenth century 4 cases came to light 2 reported by Caulton and 1 each by Littre and Petit. Sixty-one cases are reported during the nineteenth century and 88 during the twentieth. This makes a total of 154 cases up to 1936 when Herbst (9) reported his and so ably reviewed the literature. Up to 1936 no one had reported more than 4 cases. Wilmoth and Hind each have reported 4.

In the literature there is seen a preponderance of males in a ratio of roughly 2 to 1. In my 7 cases there are 4 males and 3 females.

### EMBRYOLOGY

Allantois and urachus are closely related terms and a clear understanding of their meaning and application must be gotten before the embryology and anatomy of the area can be understood.

The allantois is one of the first structures seen in the embryo. In his study of the development of the urachus in the human embryo Begg follows its origin in common with that of the upper part of the bladder from the ventral cloaca. It must be borne in mind that the intra abdominal portion of the allantois is called the urachus while the allantois proper

including the urachus runs from the top of the bladder out to its attachment to the placenta. The allantois is first seen as a sacculi in the yolk sac. When the cloaca is formed it (allantois) can be seen springing from that organ and running up through the umbilical cord toward the placenta. The bladder develops as a dilatation of the distal end of the allantois. At birth the allantois is normally present as a fibrous cord in the umbilical cord. However if the allantois remains patent, it is present as the patent urachus which may run as an open tube from umbilicus to the bladder or end as a blind pouch with no connection with the bladder. The abdominal part of the allantois, or to give it its true name the urachus, is extraperitoneal in all of its course lying between peritoneum and the posterior sheath of the recti muscles.

### TYPES OF URACHAL PATHOLOGY

1 *Exstrophy of the bladder* The bladder may open at the level of the umbilicus due to the high attachment of the bladder in the fetus, patent urachus and deficiency of the anterior abdominal wall. These cases have no doubt often been classed as simple exstrophy of the bladder.

2 *Congenitally patent urachus* This is usually seen after the umbilicus sloughs off but in some cases is seen on the day of birth. This may not develop until the child is several months old. This is often associated with stricture of the urethra and at times, dilatation of the urethra to its normal size will cause symptoms to disappear completely. Prostatic hypertrophy in later life may cause symptoms in previously latent cases, but only after a marked degree of vesical neck obstruction has developed and been present for quite a time. Such cases are not uncommon.

3 *Patent urachus and omphalomesenteric duct in the same case* There have been only

4 cases reported Lever 1898, Davey 1926, Davis and Niehaus in 1926, and Auslander and McClure 1930

4 *Malignancy* Cullen has reported 3 cases all of which had umbilical infection histories without much treatment. In 1921 Klopp reported an intramural urachal sarcoma which he treated by excision. There was complete recovery.

5 *Small urachal cysts* These are of little importance and cause few symptoms.

6 *Large urachal cysts* These often reach a very large size. Several have at one time or other been mistaken for and treated as pregnancies. Of course, time soon corrected this error. Rippmann reported one which contained 52 liters of fluid weighing 100 pounds. Most vary in size from that of an orange to a grapefruit.

7 *Abscess of the urachus* This is the most common type of urachal pathology.

8 *Cavities between the umbilicus and bladder* These are often seen. Such a case is my Case 6.

9 *Stones in the urachus* These are rare. Four cases are reported. Paget in 1850, Dykes in 1910, Slovacek in 1929, and Smoler in 1932. All patients recovered.

10 *Tuberculosis of the urachus* Tuberculosis is the rarest of all the complications. Only one case is reported. Eastman treated such a patient in 1915 by free dissection of the fistulous tract, which included the urachus, with recovery.

Of the 154 cases in the literature, the results are as follows: 107, or 69.6 per cent recovered, 13 or 8.4 per cent died, 28, or 18.1 per cent were not cured, in 6, or 3.9 per cent the result is not reported.

Of the 154 cases, 70 occurred in children under 13 years of age. Case 4 in my series was a child aged 1 year, with a large urachal abscess. This was my youngest patient. Rieder, De Geus, Mitchell, and Draudt each report a case occurring in the newborn.

The 3 most common types of urachal pathology are large urachal cysts, abscess of the urachus, and cavities formed by the patent urachus between and connecting the bladder and umbilicus or with only one.

*Urachal cysts* Large urachal cysts may vary from those containing a few ounces of fluid to

the one reported containing 52 liters. These cysts are characterized by the gradual enlargement of the abdomen in the midline between the umbilicus and the pubic symphysis. The discomfort is usually due, if present, to tension on the abdominal wall. Physical examination shows a tumor mass in the suspected area.

Differential diagnosis must be made between distended bladder, ascites, appendiceal abscess, and ovarian cyst.

The cyst is treated by means of surgical removal of the cyst cavity down to the fundus of the bladder with inversion of the bladder stump as in inversion of an appendiceal stump. Sometimes it is necessary to remove the umbilicus by a circular incision.

*Urachal cavities* One must consider whether the cavity opens only at the umbilicus and not into the bladder, whether it is connected only with the bladder and not with the umbilicus, thus forming an accessory or storage bladder, or whether it connects with both the bladder and the umbilicus. In Case 6 there is undoubtedly connection with both bladder and umbilicus because urine at times gushes from the umbilicus followed by disappearance of the tumor. At other times, the tumor will suddenly disappear following normal urination.

The symptoms are often those of the occasional case of pyelitis and the appearance and disappearance of the tumor mass between the navel and pubis. There may be an escape of urine in small amounts or a sudden gush from the umbilicus. This is often followed by the disappearance of the tumor for a while. Cystitis may develop in the accessory bladder as in the normal bladder.

Differential diagnosis must be made between distended bladder, ovarian cyst, and subcutaneous tumor or cyst.

If there is a great deal of infection present in the cavity, it is advisable to open and drain the sac. If possible, at the same time the bladder is separated from the sac and the vesical opening closed. The sac is then packed and allowed to contract down. If there is little danger of infection, the umbilicus is encircled and removed with the urachal sac and the bladder opening inverted.

*Abscess of urachus* This condition is usually easy to diagnose if the umbilicus is examined,

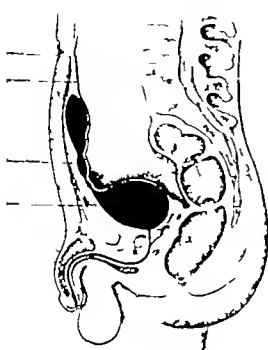


Fig. 1. Accessory bladder

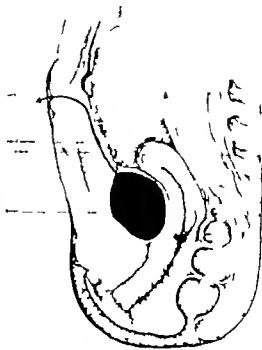


Fig. 2. Patent urachus

as it is nearly always inflamed, discharging pus, and bulging. These abscesses are due to secondary infection of a urachal cyst or urachal cavity. The infection may be introduced through the umbilicus or ascend from the bladder following pyelitis. There is pain on pressure on the surrounding area with some tenderness in the lower abdomen. The other signs and symptoms of infection are present. Case 3 is an example of a large urachal abscess.

Differential diagnosis must be made between appendicitis, pelvic abscess, distended bladder, and retroperitoneal malignancy.

The treatment is incision and drainage with no attempt being made to remove the abscess sac as there is danger of opening the peritoneal cavity with resulting peritonitis. The important point to remember is that the patent urachus is extraperitoneal and that as long as there is only incision and drainage of the abscess no intra-abdominal damage will be done.

Following are brief histories of the 7 cases. Five can be listed as small cysts that had be-

come infected and had to be removed. In Case 3 there was a large urachal abscess. In Case 6 an accessory bladder had not come to operation as patient had been lost sight of. Of 7 cases, 6 patients were operated on with cure while the other refused operation.

#### CASE REPORTS

CASE 1. M. C. F. G. came in complaining of pain in the lower part of the abdomen, and drainage of pus from the umbilicus. At intervals he had had purulent discharge from the umbilicus all of his life. For the past 3 days the discharge had decreased and the pain increased. The past and family history was of no interest. Physical examination showed the abdomen flat and with tenderness in the lower portion. The umbilicus was often red, not inflamed. A fluctuant mass was felt. A diagnosis of infected urachus is possible here was made.

At operation the urachus was found to be infected but without abscess formation. The urachus was patent down to but not to the bladder. The urachus was removed and the stump tied off and inverted. The abdominal cavity was accidentally opened. The patient recovered without complication.

CASE 2. M. R. W. came in complaining of pain around the navel. About 2 weeks previously he had

begun to have pain around the navel, especially on the left side and down toward the bladder. There had been pus drainage from the umbilicus and at one time the patient "got the core out." The pain at one time went to the right side and for a while he thought that he had appendicitis; this later stopped. The pain was now present as a dull aching in the region of the navel. There was no past history of umbilical infection. There was a slight increase in the number of leucocytes, the temperature was 99 degrees F, and the pulse 84. All other physical signs were negative except in the umbilical region. It was inflamed and there was a purulent discharge. Slight pain and tenderness were present on the left and below the navel. At operation an infected urachus extending down about half way to the pubis was removed. The wound was closed with drainage and there was an uneventful recovery.

**CASE 3** A baby girl, age 1 year, was brought in with a greatly swollen abdomen. The baby had been ill for the past 7 or 8 months. She had had repeated crops of boils that had not yet yielded to medical treatment. For the last 5 to 6 weeks the abdomen had been gradually swelling. There was no fever or apparent pain. There was a small amount of pus in the urine. The white blood count was 20,000, polymorphonuclears, 77 per cent, lymphocytes, 23 per cent.

On physical examination the child appeared to be acutely ill. There were many small pustules on the head and neck, and the color was poor. The abdomen showed a large, soft, dome-like mass extending from the pubis to just above the umbilicus, which was pushed up on top of the swelling. The swelling was dull on percussion, rather hard, and slightly tender on palpation. The umbilicus was distended to paper like thinness. A diagnosis of abscess or cyst of the urachus was made.

At operation about a pint and a half of pus was drained from the abscess. The abscess cavity was packed with iodoform gauze and a hard rubber drain was left in the cavity. The cavity did not open into the bladder. The peritoneum was not opened. The child recovered rapidly and has had no return of symptoms or signs.

**CASE 4** Mr L L B had a slight, irritating discharge from the umbilicus for 3 weeks, which had gotten worse. A week before presenting himself there was pain, swelling around, and discharge of pus from the umbilicus. He had had fever 101-102 degrees F, but no chills. At no time had there been a discharge of urine from the umbilicus. He had had several similar attacks in the past 15 years but none so severe as this. The leucocyte count was 12,000. The umbilicus was swollen and on pressure pus gushed from it. There was a swollen, inflamed area for about 10 centimeters around the umbilicus. Operation was advised.

At operation the urachus and umbilicus were cored out, a drain tube was put in, and the wound was closed. There was no connection between the bladder and the urachus. The peritoneum was not

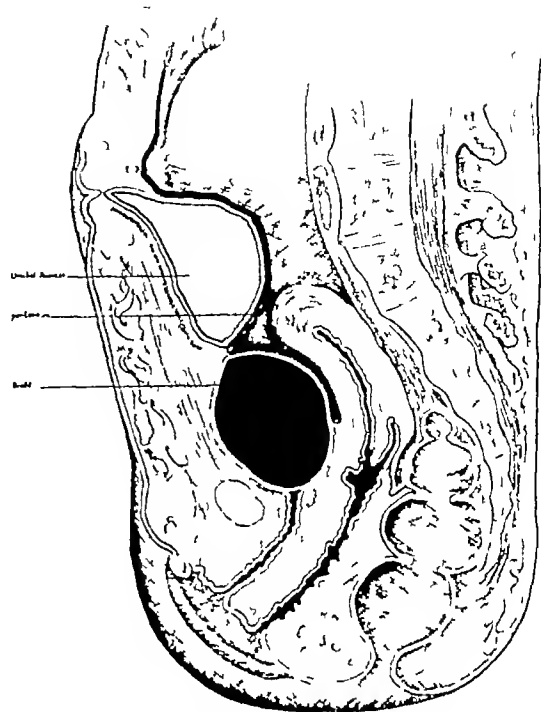


Fig 3 Urachal abscess

opened. The patient recovered without complication.

**CASE 5** Mr N P was seen in the office with an abscess pointing at the umbilicus. This was opened in the office. Local anesthesia was used. He was advised to come back in a month to have the urachus removed after the infection had died down. When seen 6 weeks later there was a slight discharge from the umbilicus, there had been no fever or chills and no active inflammation. The urachus was easily removed. There was no connection with the bladder.

**CASE 6** A negro woman, aged 30 years, was seen in the City Clinic complaining of a small mass in her stomach. This mass on examination was found to be midway between the pubis and umbilicus and was in the midline. She stated that she had had this tumor for 10 years "off and on." At times there would be a gush of "water" from her navel and then the tumor would disappear or it might disappear following normal urination. At time of examination the tumor was present and pressure on it produced a few drops of urine at the umbilicus. I was unable to empty it by pressure, however. On cystoscopic examination, a small dimple was seen in the apex of the bladder. I could make out no frank opening, but I am sure that it was there because of the history.

A diagnosis of patent urachus with accessory bladder was made, and the patient was advised to have it removed as she complained of frequent attacks of severe cystitis. She refused and has been lost sight of.



CASE 7. Dr W. Howard Wells has kindly allowed me to present this case. Mrs. R. C. F. aged 5 years, 6 months ago noticed tenderness over the umbilicus. Two weeks later it began to drain. Her doctor burned it out with silver nitrate. A week later he burned it out with an electric needle. The silver nitrate was later used at weekly intervals. Because of lack of response and increased pain in the umbilical region, the patient came to the hospital for operation. On examination the umbilicus was found to be dark red and was exuding pus. There was tenderness on pressure over the umbilicus and down the midline toward the pubis. No masses were noted. A diagnosis of infected urachal cyst was made.

At operation an infected cyst, centimeters distal to the umbilicus was found and removed. There was no bladder connection. Recovery was prompt and she was discharged from the hospital in 6 days.

#### SUMMARY

A review of the known literature on the patent urachus is presented with a report of 7 cases of patent urachus.

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# THE PATHOGENESIS AND MECHANICAL PROPHYLAXIS OF VENOUS THROMBOSIS

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THE problem of thrombo-embolism occupies a central position in medical study. During the course of past years, innumerable investigations have been carried out regarding it but without much deeper penetration into its pathogenesis having been accomplished. The reason for this seems to be that the pathologico-anatomical side of the question has previously been incompletely studied.

According to earlier opinion, which has been generally accepted since the time of Virchow and which has been especially maintained by Aschoff and his school, the femoral vein and its valve-pockets are the most frequent points of origin of deep-lying venous thrombi of the lower extremities. It has been assumed that as a result of the agglutination of thrombocytes and white blood corpuscles, a white thrombus is formed which gradually obstructs the vessel. Then, it is said, a red "coagulation-thrombus" arises in the mass of blood which is dammed up, peripheral to the primary thrombus.

This hypothesis agrees with the clinical observation that patients suffering from thrombosis feel tenderness over the femoral vein and eventually, and simultaneously with increased pulse and heightened temperature, display edema and cyanosis of the lower leg.

However, Denecke, in 1929, and Olow, in 1930, proved that the earliest clinical symptoms of thrombosis appear in the sole of the foot and in the calf. The assumption which almost immediately presents itself is that these symptoms are an expression of the very earliest formation of the thrombus, and that the process then continues upward together with the blood stream, and not, as was formerly supposed, in a retrograde direction from the femoral vein. Homans, in 1934, supported by

clinical and pathologico-anatomical observations, emphasized the great importance of the veins of the calf as areas of origin of an ascending thrombus.

It was first in 1937-1938, however, that Roessle and Neumann published the results of an extensive series of pathologico-anatomical investigations, in which there was fully demonstrated the dominant rôle played by the plantar veins and the veins of the calf as the seats of origin of thrombosis.

The year before the work of the first of these authors was published, the present writer, then amanuensis at the pathological department of the Caroline Institute, Stockholm, of which Professor F. Henschen was chief, commenced work on a series of problems to determine the commonest areas of origin of deep-lying venous thrombi. A detailed report of his results was published (4).

The frequency of thrombosis as found in different vein sections in my series is shown in Figure 1. The greatest incidence is in the peripheral veins of the calf and adductor musculature, and grows less toward the center.

The average age of the patients in my series is very great, consequently plantar venous thrombi are very sparingly represented. Neumann has demonstrated that such thrombi occur usually in young persons, while, with increasing age, the veins of the calf become more and more the chosen seat of an incipient thrombosis. Obstetrical and gynecological instances are also rare, and this is probably the reason pelvic thrombi are relatively few in number.

Earlier theories regarding thrombosis have taken into consideration a process of retrograde thrombosing from the larger calibered vessels back into the peripheral veins. In my series, however, the anterior tibial vein has never been thrombosed in spite of the fact that the site of entrance into the popliteal vein has been blocked by thrombi in no less

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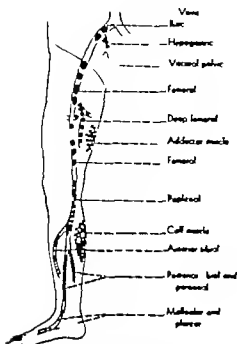


Fig. Sites of chronic thrombosis. Its number of cases for different veins of lower leg.

than 23 instances. Further I have observed cases in which the adductor veins, the deep femoral vein and the upper part of the femoral vein have been thrombosed while the lower part of this latter vein has remained free. Finally it is demonstrated in my series of cases that the veins of the calf and all of the femoral vein have been affected with thrombosis while the branches of the deep femoral vein have remained free from thrombosis. It is therefore questionable whether a retrograde thrombosis ever occurs against the direction of the blood stream.

If my series of investigations are compared with those of Roessle and Neumann we find that there are four areas of origin of incipient thrombosis namely (1) the plantar veins (2) the veins of the musculature of the calf (3) the veins of the adductor musculature and (4) the visceral pelvic veins. From these areas of origin the thrombosing process follows the blood stream and grows into the large calibered veins.

It has long been recognized that the pelvic veins are important as points of origin of

chronic thrombosis. That the plantar veins and the veins of the calf play a similar rôle has been demonstrated especially in the investigations of Roessle and Neumann. On the other hand, the importance of the veins of the adductor region as an area of origin of an ascending thrombosis has not previously been sufficiently studied. I believe therefore that it is probable in cases in which earlier investigators have observed thrombosis of the femoral vein but none of the calf that the process perhaps has usually started in the deep femoral vein and was not a primary femoral thrombosis.

More recent, wider knowledge of pathologico-anatomical conditions enables us to assume a number of new points of view regarding the problem of thrombo-embolism.

First, we may make the deduction that the four areas of origin mentioned are influenced by some special local factors connected with the patient's position in bed and that these factors gradually lead to injury of the intima of the vein. As a rule three general conditions for the rise of a thrombus must be taken into consideration, namely (1) a slowed-down blood stream (2) changed chemical composition of the circulating blood (3) injury to the intima. The first two factors are merely contributory ones in the pathogenesis and alone can never give rise to a thrombus. We know that it is possible to ligate a vein without a thrombus being formed under the presupposition of course that the intima is not injured in the process (Klemensiewicz).

The composition of the blood is changed, of course in all morbid conditions and also after operations which apparently are aseptic. The alterations consist, *inter alia* of the globulin-concentration of the blood plasma undergoing a relative increase in proportion to the albumin concentration whereby the colloidal equilibrium of the blood-plasma becomes less stable (Hueck, Loehr, Starlinger, Heusser and others). The blood thus acquires an increased tendency to coagulate but, in this connection, it is to be observed that the entire vascular system is exposed in equal measure to an increased risk of becoming thrombosed. As a matter of fact numerous examples have been brought forward which show that venesection is never entirely without this danger. Conse-





Fig. 3. Elevated head-end, to diminish the tendency to thrombosis

tuma will lie pressed against intima, while a minimal stream of blood will percolate onward through a crack like lumen which remains open in some part of the vessel.

However, there is reason to suppose that the vitality of the endothelial cells depends in high degree on their contact with flowing blood, to which the products of metabolism are delivered and from which, eventually, nutrition is obtained. When the endothelial cells are deprived of this source of nutrition, disturbances arise in them. Perhaps a purely mechanical adhesion of the endothelial layers occurs, so that some of the cells become defective or are torn loose when later on the vessel becomes distended. However it may be there is every reason to suppose that, a somewhat prolonged contact of two intimal layers gradually produces an injury to the endothelium, thus bringing about a fundamental condition for the formation of a small thrombus.

From the surface of this thrombus, however, substances are given off to the passing blood and these promote coagulation so that layer after layer of the blood-mass becomes coagulated. The process moves onward together with the circulating blood in a longitudinal direction, until finally a vein which before was pressed together becomes completely distended with the thrombotic masses (Fig. 2) and regains its circular contour. Figure 2c shows a section of the calf after complete thrombosis.

As to the finer structure of a thrombus, the rule probably holds good that a white throm-

bus arises in an area where the stream speed is great. Then the concentration of the substances which cause coagulation rapidly diminishes, and it will be mainly the leucocytes which will stick fast to the surface giving off the substances in question. (As we know the leucocytes follow the walls of the vessels while the red blood corpuscles are arranged chiefly in the center of the blood stream.) The trabecula-shaped structure of the white thrombus is explained as arising from "whirl"-formations, as shown by Aschoff in his experiments.

If on the other hand, the speed of the blood stream is slow a red thrombus will arise, as the substances causing coagulation will have the opportunity to accumulate a larger mass of blood in which process all the formative elements of the blood will be enclosed in a net work of coagulated fibrin.

That is the reason we usually find a white thrombus in the upper part of the femoral vein, at the place where the deep femoral vein opens into this vessel. For whether the process originates in the calf or in the adductor region the uppermost end of the onward growing thrombus mass will at the place aforementioned, be washed past by a rapid blood stream, and thus give rise to a white thrombus. It is this latter which, in Aschoff's thrombus-theory is called the "thrombus-bead" understood as being the primary part of the thrombus mass. Today however such an hypothesis could probably hardly be maintained.

In the reasoning given, I have had in mind the veins of the calf and of the adductor mus-



Fig. 4. a. Palpation of the calf and adductor regions for making an early thrombus diagnosis. b. Palpation of thigh.

culature, but the same arguments can be used to some extent in respect to the two other sources of origin of thrombi, namely the plantar veins and the pelvic veins.

For, under normal conditions the plantar veins are kept distended by the highest blood column existing in the human body. One can then certainly take for granted that, in many persons who are confined to bed, these veins will usually be collapsed.

As regards the rise of thrombi in the pelvic veins, probably an important rôle is played in the matter by infections, toxic products, and traumatism during operation. But in the pelvis, too, one may certainly suppose that altered meteorism, pregnancy, etc., possibly in conjunction with a failing circulation, may cause the veins to be insufficiently distended and, in consequence, become the seat of a thrombus in analogy with the process described in the case of the extremities.

#### PROPHYLACTIC MEASURES

If these ideas regarding pathogenesis are correct, then the prophylactic measures hitherto employed must be altered. Formerly all mechanical measures have aimed at the emptying of the venous system of the extremities and to do this the foot of the bed has been raised or diverse other mechanical measures have been used. Such measures, however, help to aggravate conditions which must be present if collapse of the veins and adhesions of endothelial cells are to occur. During the past few years the results of prophylactic measures used have

been so unsatisfactory—in some instances the increase in number of cases of thrombosis has been as much as tenfold—that there is every reason, supported by the theory here presented, to try new methods of prophylaxis.

During the past year at the surgical department of the Karlshamn County Hospital, I have had the opportunity of applying another method in a number of surgical and delivery cases which had been considered especially hazardous in regard to thrombosis. The patients had formerly had thrombi, or presented very unpromising varicose legs. Judging from all appearances, they had typical thrombus constitutions.

The method used was as follows. For 1 to 2 hours daily, the head of the patient's bed was elevated by placing the two head-legs upon chairs (Fig. 3). The patient then began to slide downward in the bed, and had to press her feet against the foot of the bed in order to maintain her position. She automatically made slight movements with the knees and changed the position of the feet every now and then, thereby lessening the pressure on the musculature of the calves and adductors. In the movements thus carried out, it was necessary to use both these groups of muscles to make active contractions. The venous pressure in the extremities rose, and this helped to maintain the distention of the veins.

The position causes but very slight unpleasantness to the patient, and none of them thus treated had any thrombi. During the same period, however, we had several cases of throm-

bis among patients not treated as described. One died of a pulmonary embolus.

It is true that at times a condition of collapse after operation makes it necessary for the patient to lie with the head low but if care be taken to keep the venous system distended with blood for an hour or so each day I believe that the tendency to thrombus formation will be counteracted to a high degree even if not entirely so.

As a further argument for this treatment I should like to point out that, as a rule a patient remains free from thrombi if it is possible to allow her to be up after a few days following operation. If this is not possible an endeavor should be made to place the patient in a position which resembles the upright as far as possible and not in a position with the legs high.

The results in the treatment of thromboembolism depend however to a very great extent on the ability to make an early diagnosis. Diagnosis must be made long before the signs of a more massive thrombosing become evident in the form of cyanosis edema, and increased pulse and temperature. Before a patient is allowed to leave her bed therefore extremely careful palpation must be made of the four areas of source from which a thrombus usually comes. Palpation of the calf (according to Olow) should be carried out as shown in Figure 4 a with both knees symmetrically abducted the musculature of the extremities thus becoming completely relaxed. It is then possible to palpate the calf musculature exactly on both sides. Then the medial posterior part of the thigh is thoroughly palpated bimanually and with gentle movements of the hands (Fig 4 b) I have found that a slight increase in consistency or tenderness in deep-lying parts within this area, is a valuable early symptom of thrombosis.

#### SUMMARY

Several series of pathologico-anatomical investigations have been made during past years and have proved that there are four areas of origin of venous thrombosis (a) the plantar veins (b) the veins of the musculature of the calf (c) the branches of the deep femoral vein in the adductor musculature and (d) the visceral pelvic vein.

2 When a patient is confined to bed the veins of the areas mentioned, to a certain degree are collapsed or pressed together so that two intima layers come into close contact.

3 The vitality of the endothelial cells depends, to a great extent, on their contact with flowing blood and when the cells are deprived of this source of nutrition disturbances arise in nutrition and a thrombosing process is begun.

4 Injury to the intima is the most important factor in the pathogenesis of thrombosis. It can be counteracted by raising the head of the bed so that the patient begins to slide downward in bed. Then the venous pressure in the extremities will rise so that the veins become distended with blood, and the patient will be forced to make active movements with her legs to maintain her position. Thus the veins which are especially threatened by thrombosis will be rhythmically emptied and distended.

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# VITAMIN B<sub>1</sub> DEFICIENCY IN PREGNANCY AS INDICATED BY A TEST FOR OBT PRINCIPLE

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**N**UMEROUS articles have appeared indicating that a deficiency of vitamin B<sub>1</sub> occurs frequently in pregnancy and that this deficiency may be overcome by administration of the vitamin. The symptoms of this deficiency have been reported as polyneuritis, hyperemesis gravidarum, numbness and tingling of the fingers and toes, tenderness of the extremities to pressure, muscular weakness, loss of deep reflexes, anorexia, periodic nausea, glossitis, tachycardia, edema, easily induced fatigue, etc.

One of us has reported a quantitative biological test of blood serum for estimating the effect of vitamin B<sub>1</sub> administration. The substance appearing in the blood, the level of which seems to be an index of the activity of vitamin B<sub>1</sub>, has been given the name "OBT principle." The details of the technique of the test for "OBT principle" will be found in a previous article (4).

## EXPERIMENTS

One hundred pregnant women were studied. Determinations of OBT titer was made on each at some time during the last trimester of pregnancy. After this preliminary titration for "OBT principle," each was given yeast with instructions to eat 3 cakes a day over a 4 day period and then to return for another determination of OBT titer.

It has been determined by one of us that the substance in yeast responsible for the rise in OBT titration of the serum is vitamin B<sub>1</sub> (thiamin). Yeast was used because of its low price as compared with that of thiamin (5). There were 300 international units of vitamin B<sub>1</sub> in each yeast cake.

## ANALYSIS

Analysis is made (see chart) of these patients as to age, race, development of neuritis, development of palpitation, type of delivery,

From Medical Service A Pennsylvania Hospital

months pregnant, number of pregnancies, development of toxemia (including hyperemesis gravidarum), weight at beginning and just before termination of pregnancy. Due to insufficient data only 86 of the 100 patients were included in the analysis. However, we are fortunate in being able to include several patients who had a low serum titer for OBT. Each patient was interviewed personally by one of us in order to evaluate more accurately information which was given by each of the patients.

Thirteen patients were found to be low in vitamin B<sub>1</sub>. Their average age was 26½ years, 9 of the 13 were white, the rest negroes. Ten of the 13 developed neuritis. One of the patients was delivered by cesarean section, the rest vaginally. All 13 were full term pregnancies. Seven of the 13 had hyperemesis gravidarum early in their pregnancy. Six of the 13 had definitely poor appetites. Their average weight in the first trimester was 133 pounds, just before delivery the average weight was 156 pounds.

Of the 73 patients with a normal or high titer, 57 were white, the rest negroes. Their average age was 25 years. Nine of the 57 developed neuritic symptoms—of these 7 had a low normal titer, 2000. Twenty-four had hyperemesis gravidarum early in pregnancy—OBT titer in these patients varied widely. One of these patients developed postpartum eclampsia and died. OBT titer in this patient during pregnancy was 5,000 before and after ingestion of yeast. It was repeated during eclampsia seizure and remained at 5,000. Only 10 patients had a poor appetite and 8 of the 10 had a normal low titer of 2,000. Their average weight in the first trimester was 130 pounds, just before delivery 152 pounds. In 77 of the 79 patients who returned after ingesting 12 yeast cakes, the OBT titer was definitely raised. The rise was assumed to have resulted from vitamin B<sub>1</sub> (5).



### ANALYSIS OF CASES

No.	Partials	ONT later before year	ONT later days after year	Age	Race	Sex	Pol.	Rel.	Type of delivery	Mo. per mo.	Para.	Time	Appar.	Weight before part delivery	Weight after delivery
	J S	2,000	000	27		+	+	-	OF			at h	good		27
	M J	1,500	Did not return			-	occ	-	S			at h	fair	15	142
	C P	1,500	Did not return	22		+	occ	-	S			h	fair	05	120
	A Y	2,000	1,000	26		al	-	++	LF	10		h	fair	04	100
	J S	1,000	000	20		++	-	+	LS			h	poor	00	
	J F	2,000	1,500			++	+	+	LF			h	O K.	11	51
7	A B	2,000	1,000			++	+	+	S			h	O K.	21	1,20
	I H	1,500	1,000	26		+	-	+	OF			-	O K.	00	20
	M M	1,500	000	24		al	-	-	LF			h	O K.	13	125
10	L D	1,250	Did not return	24		+		++	LF			-	O K.	05	21 A
	R W	30	1,000	18		++	+	+	CS	8		-	fair	20	200
	Mrs K.	1,500	1,000	20		al	-	++	S	8		-	poor	11	
	Mrs V	2,000	1,000	26		+		+++	S	0.15		h	fair	7	27
14	A H	300	200 (like others)	26					LF				good	18	140
3	A J	000	20,000			al		al	OF				good		140
16	M B	2,000	1,000	20		+	-	-	S				good	045	177
	M M	1,000	1,000	24		-	-	-	S			-	good	7	21
18	A M	1,000	20,000	26				-	S			-	good		21
20	E C	1,000	1,000						S				good	7	7
22	S M	1,000	1,000			+	al	al	S			S	good	08	208
	H M	1,200	20,000						S			-	good		005
22	S W	1,250	1,000	20					OF				good	08	20
	R F	1,000	Did not return	25		al	-	-	LF				good		21
24	I S	1,000	1,000	24			-		S				good	10	22
25	A C	1,200	20,000	24					LF				good	23	140
26	M B	300	300	19		al	-		OF			h	good		23
27	A L	300	20,000	22					S				good	144	045
28	C	1,000	300			al		al	S				good	17	203
29	M S	2,000	10,000	23		-	al	al	S				good		205
30	A Y	000	20,000	22					S				good		
31	D S	1,200	1,200	26		-							good		
	J F	1,200	Did not return						LF			h	good	12	
	M S	1,000	20,000			+			S				good	100	120
34	A F	1,000	20,000	20									good	202	75
	S	1,200	11,250	22					LF				good	100	20
36	C D	2,200	8,000	27			-		LS				good		20
37	L F	300	1,000	26		al		+	LF				good	20	27
	M	1,200	10,000	22									good	25	20
39	D	1,200	20,000	20			+	+	LS				good	20	217
40	I C	1,000	1,000						LS				good	205	
	N T	1,200	1,000	22		al			MS				good	26	141
42	F	300	300	20									fair		14

ANALYSIS OF CASES, *Continued*

No	Initials	OBT titer	OBT titer	Age	Race	Neu- ritis	Palpa- tion	Edema	Type of deliv- ery	Mos preg- nant	Para	Toxe- mia	Appet- ite	Weight before preg- nancy	Weight after delivery
		Before yeast	4 days after yeast												
43	R M	2 000	5 000	18	w	+	-	+	LF	9	1	sl h	good	122	152
44	N T	2 000	5 000	31	w	-	-	+	S	9	2	-	good	139	153
45	M L	2 000	10 000	28	w	-	-	-	S	9	2	-	good	106	125
46	C G	2 500	10 000	19	w	-	-	-	S	9½	2	-	good	135	168
47	C L	3,300	10 000	23	w	-	-	-	S	9	1	h	good	144	177
48	C D	3 300	8 000	33	w	-	-	-	S	9	3	-	good	118	136
49	M C	2 500	5 000	22	w	-	-	-	S	9	2	-	good	104	124
50	H A	3 300	5 000	28	c	-	-	sl	S	9	4	-	good	163	190
51	G D	2 000	5 000	28	w	-	-	+	S	9	2	h	good	107	129
52	C R.	2 500	3 300	19	w	-	-	-	OF	9	1	h	good	95	130
53	B N	2 000	5 000	26	w	sl	-	-	LF	9	1	h	good	122	155
54	K. B	2 500	10 000	23	w	-	-	sl	LF	9	2	-	good	139	164
55	K. R.	2 000	20 000	18	c	-	-	sl	OF	9	1	-	good	111	131
56	A D	2 000	3 300	28	w	sl	+	++	S	9	1	h	good	130	166
57	J C	2 500	Did not return	24	w	-	-	sl	LF	9	1	-	good	?	154
58	C G	3,300	Did not return	18	w	-	-	-	OF	8	1	-	good	113	140
59	E M J	2 000	10 000	27	w	-	-	sl	Br	9	2	-	good	202	218
60	A M	2 000	3 300	27	w	-	-	sl	CS	9	1	-	good	101	120
61	S B	2 500	Did not return	21	w	-	-	+	LF	9	1	-	good	121	147
62	T A	2 500	Did not return	27	w	+	-	+	S	9	1	h	good	150	180
63	F W	2 000	5 000	28	w	+	-	+	Br	9½	1	-	fair	131	161
64	M B	2 500	5 000	25	w	+	-	++	S	9	3	-	good	179	223
65	S M	2 000	10 000	22	w	+	-	+	OF	9	1	h	good	?	157E
66	M T	500	10 000	22	w	+	-	++	OF	9	1	-	poor	116	155
67	A S	2 000	10 000	20	c	+	-	-	S	9	2	-	good	134	152
68	A D	3 300	Did not return	27	w	-	-	sl	CS	9	2	-	good	118	128
69	E D	5 000	Did not return	28	w	-	-	-	S	9½	2	-	good	150	175
70	K. C.	2 500	3 300	14	c	-	-	-	LF	8½	1	h	good	98	114
71	G P	2 500	Returned (Did not eat yeast)	21	w	-	-	-	CS	8	2	-	good	96	122
72	J B	2 000	10 000	30	w	+	-	++	S	9	11	h	good	129	146
73	K. S	10 000	Did not return	24	w	-	-	+	LF	9	2	h	good	130	164
74	Mrs S	3,300	10 000	18	c	-	-	-	MF	9	1	-	good	110	130F
75	M J	2 000	10 000	20	c	-	-	-	LF	9	1	-	good	?	136
76	Mrs C	3 300	10 000	22	w	-	-	+	LF	9	1	-	good	95	123
77	Mrs F	2 000	Did not return	22	w	-	-	++	LF	9	1	-	good	122	158
78	Mrs S	2 000	5 000	17	c	-	-	-	LF	9	1	-	good	114	143
79	J F	2 500	4 000	2	c	-	-	-	S	9	2	h	good	84	107
80	M M	3 300	Did not return	21	w	-	-	+	LF	9	1	h	good	133	161

## ANALYSIS OF CASES

No.	Initials	NET Lever before year	NET lever day after yrs	Age	Race	Men- str.	Fal- lacies	Edema	Type of deber- ary	Men prev. year	Para.	Ten- ten	Apper- ture	Weight before prev. month	Weight after delivery
	J S	.600	.600	27		+	+	-	OF			sl b	good		171
	M J	1.600	Did not return	31		-	occ	-	S			sl b	fair	36	11
	C P	.600	Did not return			+	occ	-	S			b	fair		10
	A F	.600	1.000	26		sl	-	++	LF	70		b	fair	166	120
	J S	.600	1.000	20		++	-	+	LF			b	poor	84	11
	J F	1.500	1.500			++	+	+	LF			b	O K.	51	150
	A B	.600	1.000			++	+	+	S			b	O K.		120
	I H	.500	1.000	6		+	-	+	OF	2		-	O K.	100	70
	M M	.600	1.000	21		sl	-	-	LF			b	O K.	17	136
10	L D	1.100	Did not return	29		+	-	++	LF			-	O K.	100	75
	E W	.50	1.000	13		++	+	+	OF	2			fair	36	260
	Mrs. K	1.600	1.000	20	w	sl	-	++	S	2		-	good	35	
	Mrs. V	.600	1.000	26		+	-	++	S	1		b	fair	?	71
	A H	.500	.500 (size 6 shoes)	26		-	-	-	LF			-	good	56	100
11	A J	1.000	10.000		w	sl	-	sl	OF			-	good	17	157
12	M B	.600	1.000	20		+	-	-	S				good	105	177
13	M M	1.000	1.000	14				-	S			-	good	?	111
14	A M	1.300	10.000	26		-	-	-	S				good	11	17
15	E C	1.000	1.000	25	w	-	-	-	S			-	good	?	?
16	S M	1.000	1.000			+	sl	sl	S			S	good	96	263
	H M	1.000	10.000	21		-	-	-	S			-	good	53	96
18	S W	1.300	1.000	29		-	-	-	OF	26		-	good	36	10
	R P	1.000	Did not return			sl			LF				good	17	11
19	I	1.300	1.000	21		-	-	-	S				good	10	11
	C	1.300	10.000	21					LF				good		100
20	M B	1.300	1.300			sl	-	-	OF			b	good		
21	A L	1.300	10.000	21				-	S			b	good	111	96
22	C B	.600	1.300			sl		sl	S				good		107
23	M	1.000	10.000	11				sl	sl				good	170	108
24	A Y	1.000	10.000						S			b	good	36	17
	D S	.500	10.000	26				-					good		11
25	J F	.500	Did not return						LF			b	good	11	
	M S	1.000	10.000			+			S				good	17	17C
26	A P	1.000	10.000	20									good	16	175
		1.300	1.300	23		-			LF				good	100	20
27	C D	1.300	1.000	27					LF				good	11	140
28	T	.500	.000	26		sl	-	-	LF				good	20	57
29	M S	1.300	10.000	27									good	36	170
30		1.300	10.000	29				+	LF				good	11	17D
31	C	.000	1.000	11					LF				good	100	
32	T	.000	.000	21		sl			S				good	14	104
33	P B	.000	1.300	29									fair	11	11



ANALYSIS OF CASES, *Continued*

No.	Is this	OBT level before onset	OBT level days after onset	Age	Race	Menstr.	Pulse before	Edema	Type of delivery	Mat. wgt. at onset	Pain	Tenor. at onset	Age at onset	Weight before pregnancy	Weight at delivery
1	Mrs. C.	2,300	Did not return			—	—	+	M	50		—	good	36	
2	M. Z.	2,300	2,000	36		—	—	—	S			—	good	33	37
	Mrs. B.	2,300	Did not return	29		—	—	—	S			h	good	36	36
3	J. O.	2,300	20,000	30		—	—	—	L.F.			h	fair	140	127
4	Mrs. B.	2,000	20,000	33		—	—	—	S			—	good	7	174
5	Mrs. C.	2,300	2,000	25		—	—	—	S	50		h	fair	15	

w—weak

is—

b—

A—

B—

C—

s—

L—

M—

S—

L.F.—

h—

S—

L—

M—

S—

L.F.—

h—

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L.F.—

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## SUMMARY AND CONCLUSIONS

1. Thirteen pregnant women, from a total of 100 studied by a test on blood serum for the effect of vitamin B<sub>12</sub>, were found to be low in titer. This would indicate the frequency of this deficiency in pregnancy.

2. The OBT level—details of test given in previous article—can be raised by the administration of yeast over a 4 day period.

3. Patients judged to be low in vitamin B<sub>12</sub> by this test have a definite tendency to develop neuritic symptoms.

4. One patient who developed eclampsia, had an adequate titer of OBT.

5. From this study it would appear that a deficiency of vitamin B<sub>12</sub> in pregnancy has a definite effect upon the appetite.

We desire to thank Dr. North Vaux, Dr. Robert A. Kumbrough and Dr. Clifford B. Lull for permission to use the listed cases of pregnancy from their services.

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# CLINICAL SURGERY

## THE SURGICAL TREATMENT OF GASTRODUODENAL ULCERATIONS

### The Technique of Gastric Resection

M E STEINBERG, M D, Portland, Oregon

**P**ARTIAL removal of the stomach is more important in the cure of ulcer than the removal of the ulcer itself. A partial palliative gastrectomy occasionally is indicated when a large callous ulcer is situated near the cardia, in spite of the fact that the ulcer is not removed, the patient obtains instantaneous relief. The cause of pain apparently is not always in the seat of the ulcer itself. In cases of long standing callous penetrating ulcers there may be certain periods of freedom from pain. Possibly, when a spasm of the motor part of the stomach takes place from a new attack of gastritis, increase in the acid value of the gastric juice, or other unknown causes, the symptoms may be aggravated.

The technical details and the various methods used in performing gastrectomy definitely affect mortality and morbidity. Functional results frequently are influenced by the anatomical relationships between the stomach and the jejunum. It is for this reason that every statistical study of results, especially regarding morbidity and mortality following stomach resection, should include a detailed description of the technique used.

It is not the purpose of this paper to present a historical background for the operation to be described. We should, however, not fail to mention Finsterer's contributions to the advancements made in surgery of peptic ulcer, in numerous publications he has described his modification, based on his wide experience, of the Billroth II operation.

Before a surgeon selects a method of procedure, he should familiarize himself with the evolution of stomach surgery and, through a thorough analysis of the literature, acquaint himself with the safeguards advocated as well as with the disappointments and errors of others.

Only few complications are unpredictable. What may appear as unponderable variations in tech-

nical details, unless carefully carried out, may assume major importance. An extra suture or two at the lesser curvature of the gastrojejunal anastomosis may not only protect this corner against an undue pull, but will cover a small terminal part of the stomach which may be devoid of its blood supply. I have observed 2 instances at postmortem examinations in which leakage from the proximal lesser curvature angle of the anastomosis occurred after gastrectomies performed by the chief surgeon of one of the well known European clinics. Too much suturing at this corner will be instrumental in producing an acute angulation with temporary stasis in the duodenum which may endanger the duodenal stump. On the other hand, too little suturing at the same corner may cause an angulation downward and allow the escape of stomach contents into an atonic and dilated duodenum. A hemorrhage from a smaller or larger blood vessel in the mesentery or in the line of anastomosis may cause troublesome or fatal complications. Thus we see that numerous details present themselves which are important factors in bringing about success or failure.

#### TECHNIQUE

There should be no undue haste in the search for the offending lesion, neither should there be undue haste in the selection of the safest method of removal. Retreat after irreparable manipulations or proceeding to completion of operation with an unsafe or unsound method will prove equally fatal.

If no ulcer is found on inspection or palpation a few blood vessels along the greater curvature, about 4 to 5 centimeters from the pylorus, are ligated and severed. Adhesions between the mesocolon and the posterior wall of the stomach are separated. The posterior wall of the stomach along the lesser curvature is inspected and palpated. The posterior wall of the duodenum is also

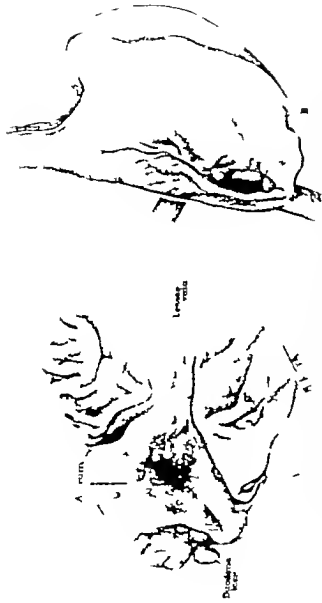


Fig. 20. The patient had been operated on by the author 7 years ago for an acutely bleeding duodenal ulcer. He was completely free from symptoms until the developed acute leucostoma and died at another hospital after surgical intervention. The patient underwent a hard labor before and after the intervention. A. Medial part of the stomach removed by operation showing duodenal and pyloric ulcer. B. Severe gastritis. C. Postoperative specimen. Inferior all of the remaining stomach has been removed. A. Gastric ulcer. This is a typical Billroth II stomach resection as popularized by Luerer and presented in its patient.

*The Surgical Treatment of Gastric and Duodenal Ulcerations — M. K. S. S. S. S.*

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From the Emanuel Hospital



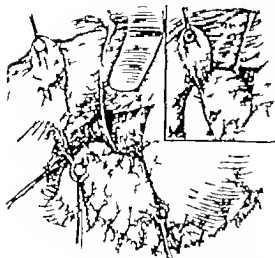


Fig. 1. Gall bladder released from adhesions to the anterior duodenal wall and the pylorus. Insert, gall bladder adherent to the ulcer on the anterior wall of the duodenum.

examined. The finding of a large ulcer penetrating into the pancreas may at once suggest the course of action to be taken. Large lymph nodes frequently indicate the presence of an ulcer malignancy or gastritis. The lymph nodes may point to the location of the ulcer. The avascular area in the gastrohepatic omentum may also be opened and the finger introduced along the lesser curvature and the posterior wall toward the esophagus in search of an ulcer. If no ulcers are found, an opening is made in the anterior wall of

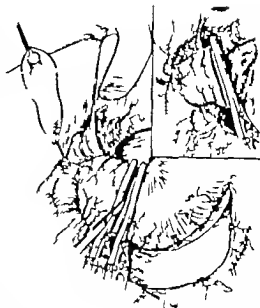


Fig. 2. Distal part of the stomach divided. Insert, the thick muscular layer turned down to the pylorus. Mucosa is eventually removed. This pyloric stump may be utilized for the author's pyloroplasty closure of the duodenum or for the Finsterer excision operation. With the clamp on the pyloric stump, the adhesions on the posterior wall of the duodenum may be divided with more convenience and the pyloric stump eventually removed if typical closure of the duodenum is contemplated.

the stomach. The contents are aspirated and sponged and the hand is introduced for palpation. The anterior and posterior walls of the lesser curvature are examined. The use of wide retractors also helps in the inspection and palpation of the interior of the stomach. The index finger is introduced through the pylorus into the duodenum.

One must be careful lest the finger be pushed through a fragile area of granulation tissue and penetrate through the posterior duodenal wall. Such an accident accounted for one of our fatalities. Even though this thorough examination reveals no lesion, it does not necessarily mean that none is present. On one occasion the stomach was resected for duodenal ulcer and a good sized chronic ulcer was found on the lesser curvature. Although thorough examination of the interior of the stomach had been negative. Recently, roentgenogram was negative for duodenal ulcer and none was found by the palpating finger introduced through the pylorus. An incision was made into the duodenum, however, and

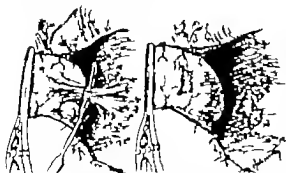


Fig. 3. Adhesions between the posterior wall of the stomach and the pancreas separated. This pyloric stump, after the mucosa is removed, may be utilized as the author's pyloroplasty closure of the duodenum or as Finsterer excision operation with the mucosa removed. Or it may be altogether removed and the duodenum closed in typical manner.



Fig 4 The author's pyloroplasty closure of the duodenum a, left, The serosa of the anterior wall of the duodenum which has been mobilized covers and tampons the ulcer on the posterior wall of the pancreas The thickened part of the muscle of the distal pyloric stump has been previously removed b, The distal pyloric stump, which has been flared open, and with the mucosa removed, is sutured over the anterior wall of the duodenum

a linear ulcer of the lesser curvature of the duodenum was revealed near the papilla, measuring about 2.5 centimeters In still another patient the opening of the duodenum revealed an obstruction at the papilla The x-ray examination revealed only an obstructive lesion at the outlet of the stomach

When an ulcer of the duodenum is found, the important problem is to determine whether the ulcer can be removed safely Such orientation

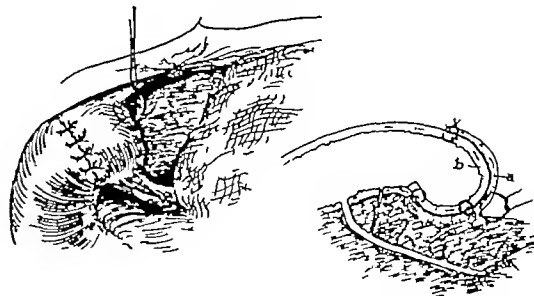


Fig 5 The author's pyloroplasty closure of the duodenum a, left, The pyloric stump flared open and denuded of its mucosa is sutured to the anterior wall of the duodenum A few sutures are applied between the serosa of the wall of the stomach and the thickened pancreatic capsule b, The cross section view of the pyloroplasty closure of the duodenum plugging the ulcer bed penetrating into the pancreas

depends on an adequate incision and the good exposure of the first part of the duodenum of the gall bladder, and, under certain circumstances, of the common duct An ulcer adherent to the gall bladder or hepatic flexure more frequently may be dissected away from adhesions with safety If an opening should be made in the anterior wall of the duodenum, it is possible to mobilize the duodenum and to use its anterior wall to secure a safe closure

At this stage it may be found necessary to decide whether or not the gall bladder should be

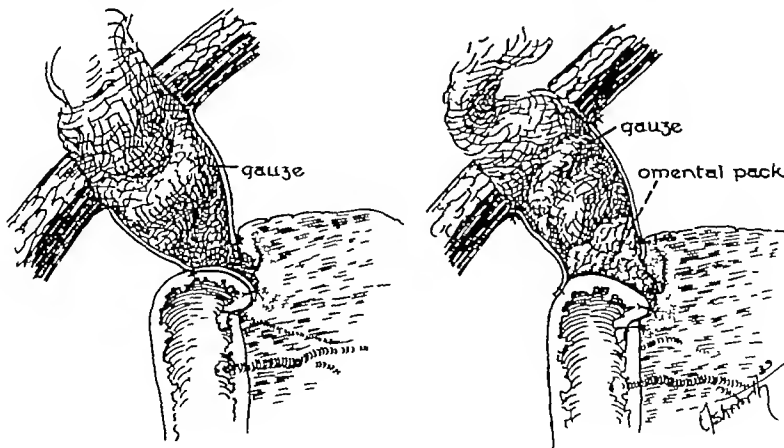


Fig 6 The author's pyloroplasty closure of the duodenum in case of an acutely bleeding ulcer a, left, The pyloric stump has been denuded of its mucosa and sutured to the peritoneum The serosa of the anterior wall of the pyloric stump has been sutured to the anterior duodenal wall Gauze packing applied to an acutely bleeding ulcer on the posterior wall of the pancreas b, An acutely bleeding ulcer on the posterior wall of the duodenum packed, transfixed with an omental plug, and with gauze pack over the omental plug

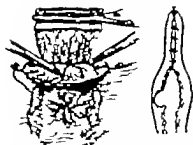


FIG. 7 a, left, Removing the antrum of the pyloric stump in Finsterer exclusion operation. b Suture of the denuded antrum of the pyloric stump as practiced by Finsterer.

removed since buried in adhesions, it may not empty itself properly and thus later be responsible for residual symptoms. If the ulcer penetrates into the duodenohepatic ligament or into the posterior wall of the pancreas, or both, resection of the duodenum including the ulcer may injure the pancreas, accessory pancreatic duct, the common duct, and even the portal vein and the

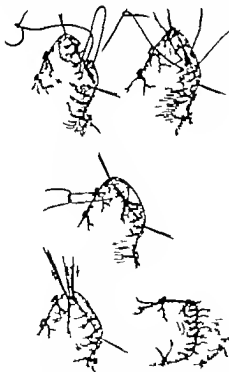


FIG. 9 Closure of the duodenum in typical manner. The last row of sutures is taken between the anterior duodenal wall and the thickened pancreatic capsule.



FIG. 8 a, left, Opening made into the anterior duodenum all for palpation, inspection, and removal of the duodenal contents. b, Inspection of the ulcer on the posterior wall of the duodenum. The ulcer on the posterior wall of the duodenum may be removed if the conditions are favorable. Otherwise the author's pyloroplasty closure can still be utilized provided the duodenum is mobilized.

hepatic artery. Though the ligation of the gastroduodenal or the pancreaticoduodenal artery is practiced by some surgeons, occasionally it may result in a necrotic area of the pancreas, for the reason that these vessels give off branches to the pancreas.

The origin of the right gastro-epiploic artery also gives off occasional branches to the pancreas, and for this reason the main stem or its branches should be ligated only along the greater curvature of the stomach.

It is apparent then, that attempts to remove ulcers which form thick and edematous inflam-

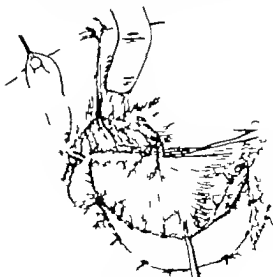


FIG. 10 The removal of the duodenal ulcer offers difficulty. Blood vessels along the greater and lesser curvatures are severed distal to the duodenum.



Fig 11 The removal of the ulcers of the duodenum offers no difficulty. Blood vessels along the greater and lesser curvatures are severed and ligated. Diagrammatic.

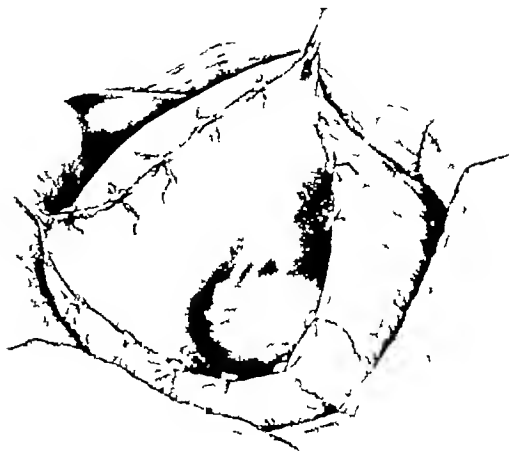


Fig 12 The removal of the ulcers on the anterior or posterior wall of the duodenum offers no difficulty. Blood vessels along the greater curvature are ligated and severed.

matory masses will result in increased mortality because of leakage from the duodenal stump, because of pancreatitis, or because of injury to the other vital structures. Peritonitis, one of the frequent causes of death, is usually caused by leakage from the duodenal stump. It is difficult, therefore, to share the enthusiasm of some surgeons with much experience who make the claim that they are able to remove with impunity every ulcer of the duodenum. Since the anatomical and pathological realities are indisputable and the fatal result after such a procedure only too frequently reported in the literature, this optimistic claim is possibly based on fortuitous surgical material.

If it is found that the typical removal of the ulcer is not safe, one of three procedures may be used. If the ulcer is penetrating and there is still a possibility of mobilizing sufficient of the duodenum proximal to the ulcer, the duodenum may be closed and the ulcer left *in situ*. When the duodenal ulcers and the first part of the duodenum are buried in a mass of thick inflammatory adhesions, the Finsterer exclusion operation may be employed. There must be no dead spaces between the duodenal ulcer and any part of the excluded pylorus which will permit retention and possibly reflex stimulation of gastric secretion. Retention in the excluded stump also may cause leakage and fatal peritonitis. It is important to reiterate that exclusion of the ulcer alone does not always protect the patient against hemorrhage, perforation, or even persistence of symptoms. One of the patients succumbed from perforation of a

duodenal ulcer following the exclusion operation and resection. Another had a hemorrhage and the symptoms persisted so that it was necessary later to remove the ulcer. Similar cases have been reported in the literature.

If the Finsterer exclusion operation is performed, at least the mucosa should be removed from the antrum so that the possibility of reflex stimulation of the secretion of gastric juice from the proximal remaining portion of the stomach may be reduced.

For the past 4 years in the majority of cases the author's *pyloroplastic closure* has been used in place of the Finsterer exclusion operation, with excellent results. Unlike the exclusion operation, pyloroplastic closure has no physiological objections. It permits direct attack on the ulcer and is especially valuable in the presence of acutely bleeding ulcer. Technically and anatomically it is feasible in the great majority of penetrating ulcers. The anterior wall of the duodenum, which is mobilized, covers and acts as a tampon to the bed of the ulcer where the bleeding vessel may be transfixed. A flap of the stomach wall denuded of its mucosa in turn is used to cover the anterior wall of the duodenum. A closure is thus made which is even safer than a typical one under the most favorable conditions. It is not necessary to expose the course of the common duct either in a typical Finsterer exclusion operation or in the pyloroplastic method. The common duct should be identified only in borderline cases when it has been decided to remove the ulcer in a typical manner.

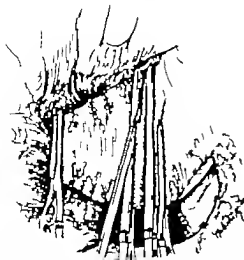


Fig. 3. The distal part of the stomach has either been utilized for the author's pyloroplasty closure of the duodenum or has been removed as in the typical duodenal closure.

The accompanying illustrations demonstrate some variations in the pyloroplasty method of duodenal closure.

In a doubtful case the following plan of action is adopted. A few blood vessels are ligated along the greater curvature of the stomach, about three finger breadths above the pylorus. The thin vascular area of the gastropyloric mesentery is opened and the branches of the right gastric artery along the lesser curvature are ligated about the same distance from the pylorus as on the greater curvature. Two Payr clamps are applied in this area and the stomach is divided. The distal stump of the stomach can be utilized either for a Finsterer exclusion operation or the a thorax pyloroplasty closure. Even if the ulcer on the posterior wall or on the anterior wall of the duodenum can be removed in a typical manner the distal stump of the stomach if held taut gives easy access to the adhesions between the duodenum and the pancreas. The division of the distal part of the stomach between two Payr clamps, as the first step makes it possible to treat the duodenal ulcer by any method which appears to be safest for the patient. As soon as a decision regarding this most important step in the resection has been made, one proceeds with a typical resection.

The blood vessels along the greater curvature of the stomach are more numerous toward the pylorus. At about the middle of the greater cur-

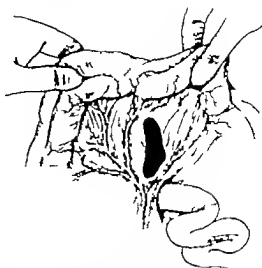


Fig. 4. An opening is made in the mesocolon close to the emerging loop of the jejunum.

vature, near the fornx, the blood vessels are farther apart. Each blood vessel is separated and ligated three times. One ligature is applied close to the greater curvature and two ligatures close to the vascular arcade. The middle colic artery runs between the gastroduodenal omentum and the transverse mesocolon. If the ligature carrier is introduced too deeply there is danger of ligating the middle colic artery. Such an accident may take place when there are adhesions about an ulcer on the lesser curvature of the stomach which penetrates into the transverse mesocolon. One must then isolate the middle colic artery first before proceeding with the actual removal of the ulcer.

When the ligation of the blood vessels is made distal to the vascular arcade the omentum may lose some of its blood supply and become dusky and cyanotic. Such an accident is to be feared particularly when the omentum is quite fat. The ligation of the blood vessels along the greater curvature is progressing toward the fornx. The extent of the reaction along the greater curvature depends upon the condition for which the reaction is performed. Resection for gastric ulcer or duodenal ulcer in older individuals, need not include much more than half of the stomach. When dilatation and hypertrophy are associated with a long standing obstruction the hypertrophy takes place chiefly in the motor part of the stomach. The frequent mistake is to remove too little of the stomach. When operation is indicated for a duodenal ulcer in a young individual with high

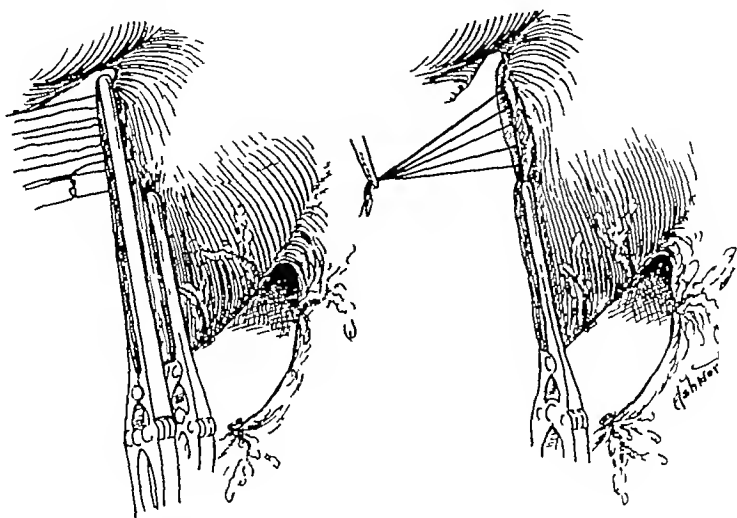


Fig 15 a, left, The part of the stomach next to the lesser curvature is being closed by mattress sutures b, The larger Payr clamp including the crushed part of the stomach has been removed The anastomosis is made where the smaller Payr clamp is applied

acidity or for jejunal ulcer, the resection should be more generous

The gastrocolic ligament at the pyloric end of the stomach separates into two leaves The anterior leaf leads to the greater curvatures of the stomach and the duodenum, and the posterior leaf leads to the posterior surface of the duodenum and the pancreas The ligation of these mesenteries in one mass may result in troublesome bleeding and the danger of ligating not only the middle colic artery but also the pancreaticoduodenal artery and the origin of the gastro-epiploic artery The posterior leaf should be ligated very carefully in order to mobilize the posterior wall of the duodenum and not to injure the pancreas Usually numerous delicate arteries and veins are present which bleed freely

The right gastric artery, as a rule, is of small caliber It gives off branches to the distal part of the lesser curvature and the duodenum This blood vessel is not always identified Usually the distal part of the gastrohepatic omentum near the duodenum is ligated, by means of 2 ligatures proximally and 2 distally The ligatures are transfixed since they are apt to slip and cause annoying hemorrhage When extensive mobilization of the superior or greater curvature of the duodenum is desired, the small blood vessels along the superior border may be ligated at this time or at the beginning These blood vessels originate either from the right gastric, hepatic, or the cystic vessels The ligature carrier should not be in-

troduced too deep, for if adhesions and variations are present, the important in the duodenohepatic ligament may be closer to the superior border of the duodenum There is, therefore, the danger of ligating the common duct, the hepatic artery, or the portal vein The ligation of the small blood vessels along the superior border of the duodenum, contrary to some opinions, does not greatly disturb the blood supply, particularly when one is sure to have sufficient of the anterior wall The main blood supply to the duodenum comes from two parallel arcades along

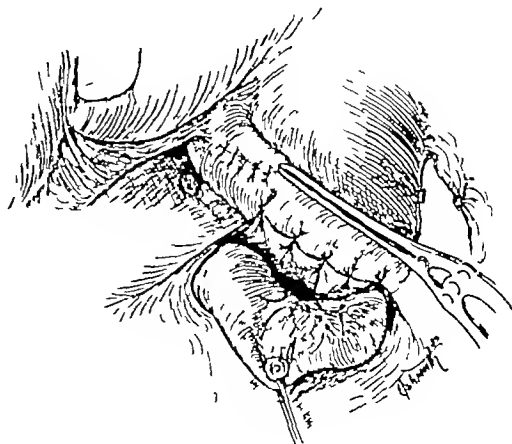


Fig 16 The left leaf of the mesocolon is sutured to the posterior wall of the stomach

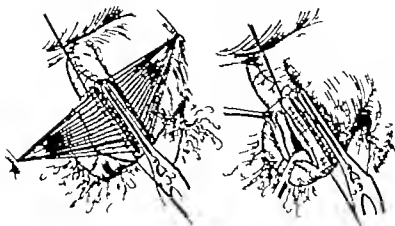


Fig. 7 a, left, The posterior wall of the jejunum and the posterior wall of the stomach has been sutured. The anterior wall and posteriorly has been incised down to the mesocolon. The hemostatic sutures on the anterior and posterior walls of the stomach has been applied and are held by forceps b, The jejunum has been opened and the hemostatic sutures cut

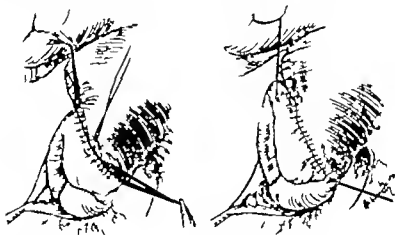


Fig. 8 Application of interrupted silk sutures to the anterior wall of the stomach

the mesentery. To facilitate the ligation of the blood vessels along the superior border of the duodenum, one assistant retracts the liver and another pulls the pyloric stump downward and to the left. The strands of connecting tissue from the gastrohepatic omentum to the posterior wall of the duodenum and to the pancreas are separated, any step of the operation which appears convenient.

In a typical procedure a Pavr clamp is applied to the pylorus and then the ulcer together with

narrow strip of the duodenum is removed. It is not advisable to use crushing clamps on the duodenal stump. Under favorable conditions when there is sufficient of the posterior wall of the duodenum left, closure with a clamp is without difficulties. However when the ulcer on the posterior wall of the duodenum or on the superior border penetrating into the duodenohepatic ligament has been removed, there is as a rule very little of the posterior wall left so that safe closure is difficult. A clamp applied crushes and de-

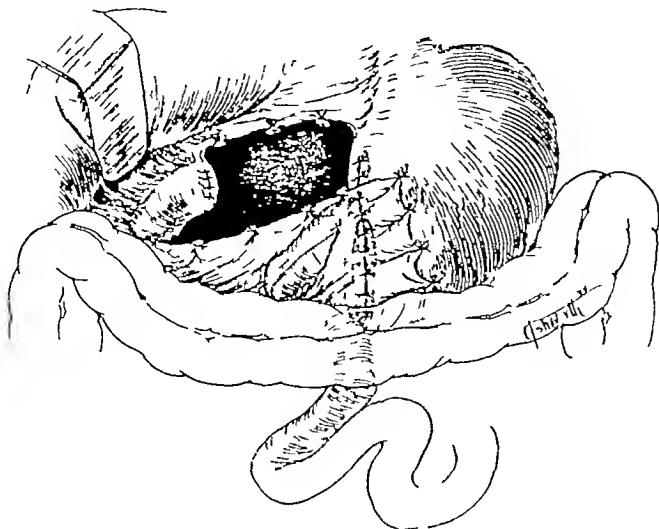


Fig 19 A diagrammatic view of the completed operation. With the omentum and the transverse colon raised out of the abdominal cavity, the anastomosis between the jejunum and the stomach assumes more often a position between the vertical and horizontal lines

vitalizes the narrow available strip of healthy duodenum on the posterior wall and jeopardizes the procedure. The opening in the duodenum is closed with an interlocking hemostatic stitch of No. 00 chromic and two rows of interrupted silk. After the anterior wall of the duodenum has been freely mobilized, there is plenty of loose tissue to invert against the thickened pancreatic capsule. The realization that duodenal leakage is responsible for a certain number of fatalities should make one hesitate lest only an esthetic closure is performed. A "Moynihan" hypnotic stitch here and there or an occasional drain will save a life. Again it is important to emphasize that mobilization of the duodenum assures a safe closure of the duodenal stump even under the most difficult circumstances when there is very little of the posterior wall left. The posterior wall of the duodenum cannot be mobilized with safety in the presence of penetrating, inflammatory tumor masses.

The stomach, which has been separated from the duodenum, is reflected to the left. The first assistant retracts the left lobe of the liver and also pushes down on the pancreas. The left gastric artery and its branches are ligated and divided along the lesser curvature. When there is a great deal of fat, one must be careful not to penetrate the wall of the stomach. In such a case it is advisable by blunt section and palpation to introduce a hemostat so as to spread apart the fat

along the lesser curvature. Frequently, particularly when a good part of the stomach is removed or when it is necessary to mobilize the lesser curvature more freely, the left gastric artery is ligated at the pancreaticogastric ligament. The ligation should be closer to the lesser curvature and should not be toward the celiac axis where there is danger of including a rare accessory hepatic artery which supplies the left lobe of the liver.

Four ligatures are introduced, 2 proximally, 2 distally. One of the proximal ligatures, which is made of chromic No. 1 catgut, is left long and grasped with a hemostat. There still remain several blood vessels on the anterior and posterior walls of the stomach which are running from the

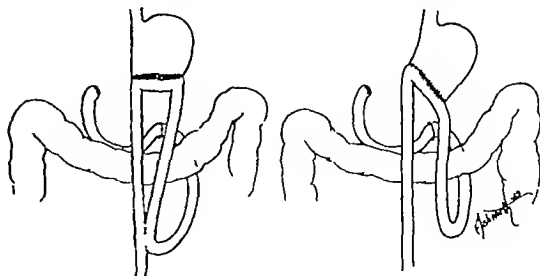


Fig 21 a, left, An antecolic stomach resection which should give no trouble. b, An antecolic stomach resection which would favor stagnation of stomach contents in the proximal loop.



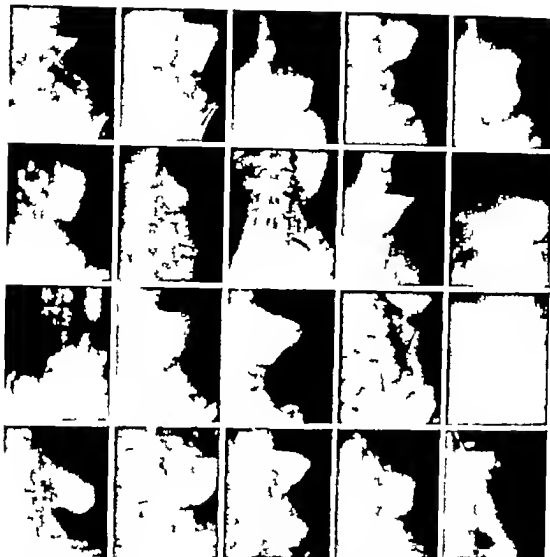


Fig. 1. A series of roentgenograms after Billroth II resections. These roentgenograms were taken about 3 to 4 weeks after the operation.

lesser curvature downward and outward. These are ligated and separated in order to free this part of the stomach for a safe closure or anastomosis. The omental tags hanging from the wall of the stomach are also removed. The ligation of the blood vessels mobilizes a great deal of the stomach wall and enables one to make the anastomosis without tension. It also robs the stomach of considerable blood supply and possibly helps to reduce the gastric acidity in the remaining part.

The stomach, which has been mobilized and freed from its blood supply and attachments in the manner described, is lifted upward and put on a stretch. Two large Parker clamps are applied to the stomach in the direction of the axis of the body so that the esophagus will be in the line of the anastomosis which is made at the greater curvature. The clamp on the lesser curvature reaches about three finger breadths distal to the esophagus. A narrow strip of the stomach along the lesser curvature is closed by interrupted through-

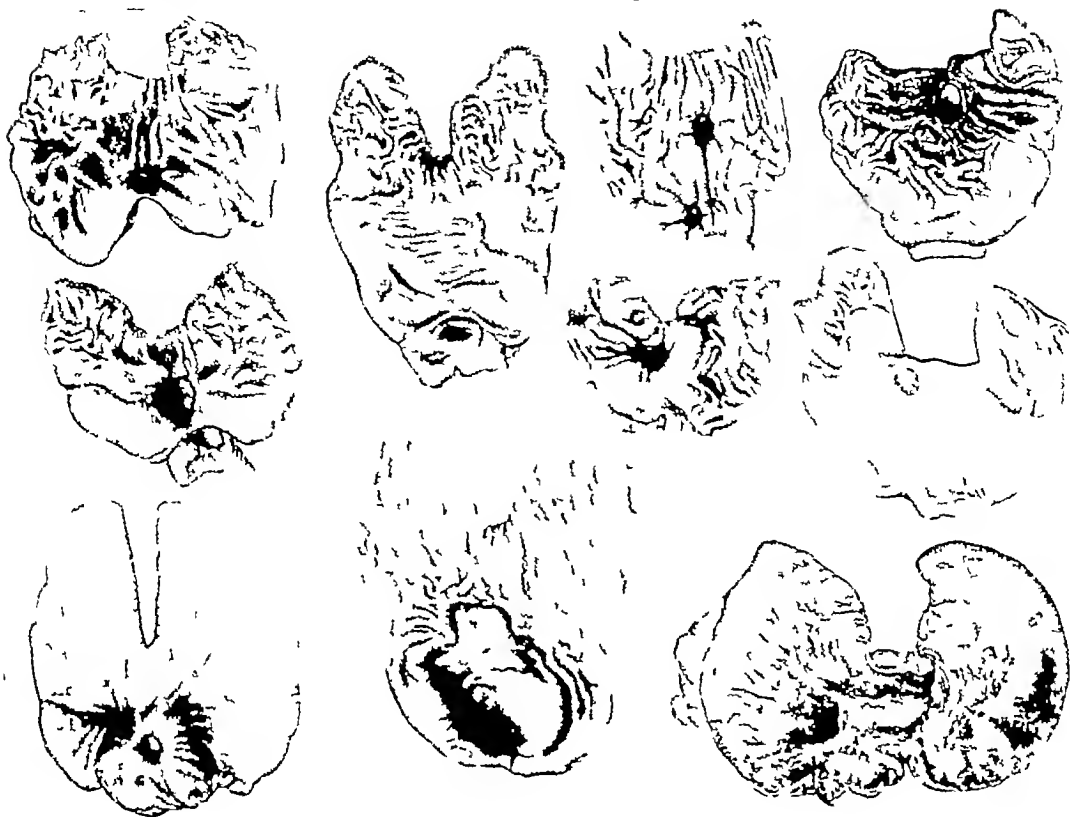


Fig 23 A group of ulcers, some carcinomatous, removed in the reported series

and-through linen sutures. A small Payr clamp is applied to the stomach along the greater curvature proximal to the large clamp. The large clamp is taken off, the crushed stomach wall is cut away, and the part of the stomach near the lesser curvature is inverted by interrupted silk sutures. A part of the gastrohepatic ligament including the ligated stump of the left gastric artery is sutured to the most proximal end of the lesser curvature of the stomach.

The transverse colon is lifted out of the abdominal cavity and the first part of the jejunum is identified. The right hand is introduced along the left side of the mesocolon and the left side of the spine, keeping in touch with the mesocolon. The loop of the small bowel which is fixed is the first part of the jejunum. This part of the jejunum, its emergence under the root of the mesentery, and its direction, must always be visualized. One must ascertain that there is not the slightest torsion of the jejunum before the anastomosis is made. Not infrequently there are adhesions

between the jejunum and posterior wall of the mesocolon which distort the direction of jejunum and obscure location of the duodeno-jejunal angle. These adhesions must be separated.



Fig 24 Specimen removed by stomach resection, a deep gastric ulcer on the surface of a large myoma



Drawn by Elise G. Merrill

Fig. 5. Histologic study of cross section through the all of gastric ulcer on the lesser curvature. Parietal cells at 1 are predominating and appear to be outside of the tubules. Such appearance is due to early digestion of groups of chief cells, and has been mistaken for carcinoma.

The opening in the mesocolon is made where the jejunum emerges from under the root of the mesentery. The incision is made in an avascular area. It should not encroach directly on the main vascular arcade. When the mesocolon is short from scarring it is inadvisable to do a retrocolic anastomosis. Depending on the conditions one may perform either a Billroth I or an antecolic anastomosis. The transverse colon is replaced. The left leaf of the mesocolon is sutured to the posterior wall of the stomach about 2.5 centimeters from the line of anastomosis. On the lesser curvature the mesocolon is sutured for about 2 to 3 centimeters, and on the greater curvature for about 5 to 6 centimeters proximal to the anastomosis. The attachment of the mesocolon higher on the greater curvature keeps the anastomosis in a vertical axis. One must be careful not to injure the blood vessels of the mesocolon. When the stump of the stomach is small only the left leaf of the mesocolon is sutured to the posterior wall of the stomach. The right leaf is then sutured to the jejunum.

The first serosal suture between the stomach and the jejunum is made of fine interrupted black silk. The jejunal loop should not be taken too close to the ligament of Treitz because the stomach pulls up higher under the diaphragm and causes dangerous tension on the line of anastomosis. On the contrary the proximal loop should not be too long because it may sag and cause

retrograde filling and stasis in the duodenum or proximal jejunum. The proximal jejunal loop should measure not less than 6 centimeters. In case a jejunal ulcer follows stomach resection, an edematous condition of the short proximal jejunal loop would make an end-to-end anastomosis very difficult. In 3 cases with jejunal ulcers the proximal loop was anastomosed to the distal one end-to-side and the gastrojejunal anastomosis was made distally.

The second row of sutures is made with chromic catgut No. 00 and is continuous. The serosa and muscularis along the posterior and anterior wall of the stomach close to the small Payr clamp, are incised with a sharp knife down to the mucosa. Hemostatic sutures are applied to the individual blood vessels. The sutures are left long and held in two hemostats. The hemostatic sutures produce puckering of the stomach wall. It is possible that it aids in establishing a mechanical control which prevents regurgitation of the bile and pancreatic juice into the stomach and prevents postoperative gastritis. The incision in the jejunum is made smaller than in the stomach. There are only a few blood vessels to be ligated. The small Payr clamp along the greater curvature of the stomach is taken off and the crushed part of the stomach wall is removed. The stomach contents are aspirated and a sponge is introduced into the lumen of the stomach. For the posterior suture line which is taken through all the layers,



blocked off with 0.5 per cent novocain in every case. After the abdomen is opened the peritoneum on each side of the midline is infiltrated with novocain. The transverse colon is delivered to the outside and the transverse mesocolon along the root of the mesentery ballooned out with the novocain solution. The mesentery along the duodenum and the right and left gastric arteries and the right and left gastro-epiploic arteries are infiltrated and ballooned out. After the stomach is skeletonized, the capsule of the pancreas is also infiltrated with the anesthetic solution. The patient is not under deep anesthesia at any time during the operation. Though it takes from 3 to 5 or even 6 hours to perform the operation. If it happens to be a complicated jejunal ulcer, thus far we have seen no shock in any of our cases. The harbitrates allow a liberal amount of novocain which in turn blocks the pathway to the higher centers. The extra time spent is compensated by a smooth convalescence. Caffein and sodium benzoate are always administered at the completion of the operation.

#### PRE-OPERATIVE AND POSTOPERATIVE TREATMENT

Only those patients who have complications receive elaborate care. If there is no obstruction the stomach is never washed before the operation. If there is an obstructive lesion, the blood urea is determined, and, if there is indication of kidney damage the patient is treated accordingly. The stomach is washed out several times a day glucose and saline are given, and also blood transfusions. In a rare case when the patient is extremely emaciated from a prolonged severe obstruction and if the condition does not improve a jejunostomy should be performed before the stomach resection is done. Jejunal feeding and other supportive measures must be instituted in order to improve the general condition of the patient and also the kidney function. Blood transfusions are given to anemic or emaciated patients.

After the patient has sufficiently awakened from the anesthetic, the head of the bed is elevated. As a routine measure the patient receives 2000 cubic centimeters of 5 per cent glucose in water and 1000 cubic centimeters of normal saline each day for the first 3 days. A Levine tube is introduced into the stomach and the contents are aspirated every hour. This tube may be removed during the first or second day for 2 or 3 hours or more at a time. A rectal tube is used on the third postoperative day. As soon as the patient is removed from the operating room he is turned several times and after he wakes, the urine is instructed to support the incision carefully so

that the patient can cough up tenacious mucus and take deep breaths. These respiratory exercises are repeated every half hour or every hour. As soon as possible, the patient is encouraged to exercise his legs and arms to improve his general circulation. Prostigmin is given 6 hours before the operation every 4 hours during the first 24 hours, and every 6 hours during the second 24 hours. No troublesome postoperative distention of any kind has taken place following a gastrectomy.

Water and sweetened tea, jello, and zwieback are given beginning with the third day. The food is gradually increased so that on the fifth and sixth days the patient receives cooked cereals, puddings, and such.

#### COMPLICATIONS

*Peritonitis.* Peritonitis rarely takes place from outside contamination unless the abdominal wound becomes disrupted. Since no clamps are used in the performance of a gastro-intestinal anastomosis, more or less spilling of the gastro-intestinal contents takes place in every gastrectomy. Piercing the needle through the whole thickness of the stomach or intestinal wall also involves a certain amount of bacterial contamination. Thus far no peritonitis has resulted in over 500 gastro-intestinal anastomoses from such soiling. This is clinical evidence of the resistance of the peritoneum against a certain degree and type of bacterial invasion.

The commonest causes of peritonitis are the following: (1) leakage from the duodenal stump—(a) the removal of callous penetrating ulcers of the duodenum forming inflammatory tumor masses, (b) from faulty closure particularly through the failure to mobilize the anterior duodenal wall, (c) the use of crushing clamps on the duodenal stump, (d) escape of pancreatic juice from the ulcer base or injured pancreas with the digestion of the devitalized wall of the duodenum, (e) escape of bile from the injured common duct, (f) ligation of the gastroduodenal, pancreaticoduodenal, or right gastro-epiploic arteries at its origin, (g) ligation of functioning accessory pancreatic duct, (h) leakage from its anastomosis—(a) necrosis of the gastro-intestinal wall through poor blood supply, strangulation of tissues or suturing of crushed tissues, (b) poor hemostasis, (c) anastomosis under tension which may produce a pull on the floor of suture ring or stretch the blood vessels in the mesentery (kinks, torsion and faulty mechanics ("vicious circle")) (e) inadequate pre-operative and post-operative treatment (3) the use of Linster's

exclusion operation in the presence of duodenal obstruction. Drainage should be instituted when the closure of the duodenal or pyloric stump appears insecure.

*Subphrenic abscess* Subphrenic abscess can be prevented in the same manner as peritonitis. Drainage should be used in case of poorly controlled hemorrhage or insecure duodenal closure.

*Vicious circle* It is outside of the scope of this paper to discuss the many possibilities which masquerade under the rather vague term of "vicious circle." The proper interpretation of all the technical factors concerned and the physiological principles involved will make a so called "vicious circle" after stomach resection an extremely rare occurrence. The use of the Levine tube and the proper pre-operative and postoperative care usually allows the emptying of the stomach contents so that small feedings can be started on the third postoperative day.

*Hemorrhage* The use of two knots on every blood vessel left in the mesenteries, also, individual ligation of every blood vessel along the line of the anastomosis, should prevent hemorrhage.

*Pulmonary* No fatal respiratory complications occurred in this series of cases in spite of the fact that there were a number of gastrectomies performed on patients in advanced age suffering from anemia and obstruction.

The following measures are used to prevent respiratory complications: maintenance of proper nutrition and vitamin supply, also, water and mineral balance before and after the operation, blood transfusions in anemic or debilitated patients, frequent breathing exercises and deep coughing to bring up tenacious mucus, immediate and frequent change of position, vigorous exercises of arms and legs, avoidance of deep prolonged anesthesia, the use of an operative technique which is meticulous in every detail in order to avoid suturing and strangulation of large masses of tissue, hematoma, and abscess formation.

Retention of gastro-intestinal contents unrelied for a considerable period of time with resulting irritation may also predispose the patient to pulmonary complications.

*Late sequelæ* No operative procedure in which the stomach is anastomosed to the jejunum can absolutely exclude the possibility of jejunal ulcers unless the acid gastric juice can be completely eliminated. From experimental laboratory and clinical experience, several conditions have been discovered under which jejunal ulcers may take place. Some authors believe that there are certain types of jejunal ulcers which are surgically incurable (Mandl). Finsterer, however, states

that radical and adequate surgery can cure every jejunal ulcer. In spite of the most radical surgery there will occasionally be a patient whose acid gastric juice will not be sufficiently controlled to prevent a jejunal ulcer. Fortunately, in my own experience such cases are rare.

In order to prevent jejunal ulcers, the resection must be a subtotal one, particularly when the acid values of the stomach contents are high and when the individual with a duodenal ulcer is young. When the stomach is dilated in the presence of a chronic obstruction, the usual mistake is to remove too little of the stomach. Kinks, torsion, or a small gastro-intestinal anastomosis is responsible for the retention of the acid gastric contents and predisposes to jejunal ulceration. An entero-anastomosis does not altogether prevent the alkaline duodenal juices from passing the gastro-intestinal anastomosis. A "Y" anastomosis, however, sidetracks the alkaline pancreatic juice and bile and is a contributing factor in producing jejunal ulcers.

If a "Y" anastomosis becomes necessary when an operation for a jejunal ulcer is done in the presence of a short, edematous proximal loop, I have placed it proximal to the gastro-intestinal anastomosis.

Finsterer's exclusion operation with the mucosa left intact has been responsible for two jejunal ulcers in this series of cases.

The modified von Eiselsberg exclusion operation, which is known in this country as the Devine operation, in the greatest majority of cases will result in jejunal ulcers. This has been demonstrated experimentally by the author and by surgical end results.

*Pressure symptoms* Few patients complain of pressure symptoms immediately after a heavy meal. These symptoms may persist for a few months or more but have rarely been serious or disabling. Relief is obtained after the patient lies down for a few minutes. Some reflex phenomenon, which takes place in the stomach and which is explained on the same basis as palpitation complained of by people with an intact stomach, may be responsible for these complaints. It may also be an exaggeration of the splanchnic reflex which takes place in numerous individuals after a heavy meal and which is characterized by dizziness and a desire to sleep or lie down. This splanchnic reflex will take place more readily and violently in an individual with a resected stomach since the food empties into the jejunum rapidly.

*Gastritis* Many of the continental surgeons have blamed gastritis and jejunitis for most of the dyspeptic symptoms which take place after stom-

ach resection. It is my opinion that some of the symptoms are due to faulty technique, inadequate surgery disabling adhesions or improper indications for operation. The presence of bile and pancreatic juice which may stagnate in the stomach may be a causative factor of gastritis and of some of the dyspeptic symptoms. Stagnation in the proximal jejunal loop or duodenum, in the presence of a previous malfunction, should also be considered as a probable cause of dyspepsia. If the puckering sutures of the stomach are used, there is the possibility that a little or no bile enters the stomach.

It must be frankly stated that the cause of some of the residual symptoms following gastrectomy have thus far not been explained to our complete satisfaction. Fortunately these complaints are not common and rarely serious.

#### REPORTED CASES

Since 1914 stomach resection has been adopted as a routine procedure for the relief of gastroduodenal ulcers. Thus far 117 primary operations have been performed. Three patients succumbed to the operation. The analysis of the case reports discloses that each of those patients was admitted to the hospital on account of severe hemorrhage.

Counts has been made on several occasions with over 90 per cent of the surviving patients. By far the great majority of these patients are free from symptoms. They do not follow any specific diet and not a few indulge in liquor and smoking in spite of admonitions to the contrary. Five patients upon whom we performed gastrectomy complain of dyspeptic symptoms but consider themselves free from the original trouble.

Brief summaries of the cases of patients who have not been benefited by operation follow.

An Italian, male, aged 40 years, operated on in 1915 for duodenal ulcer has bitterly complained on many occasions of obscure pressure symptoms after eating. He has not been seen or heard from for several years.

V. L. male, aged 43 years, Case A-6849, as operated upon, on April 1, 1936, for duodenal ulcer with complete obstruction. A Finsterer excision operation, without the removal of the antrum from the excised part of the stomach, as performed. This patient gained in weight and got along nicely until year ago when he presented himself with history of hemorrhage and typical symptoms of jejunal ulcer. He was operated upon again at the Emanuel Hospital on December 4, 1937. The excised part of the stomach removed, the jejunostomy opening was closed, and the remaining stomach reduced in size. A Finney-Haberer anastomosis as substituted for the Billroth II modification performed previously. This patient has had no complaint since his last operation and has gained 30 pounds.

R. W. male, aged 51 years, Case A-8066, operated upon February 5, 1939, for duodenal ulcer. An excision operation as performed with the removal of the antrum but

the ulcer as left *in situ*. The Finney-Haberer gastroduodenal anastomosis as used in this case. This patient improved but had some upper gastro-intestinal complaints and some pain. Finally he developed severe hemorrhage. The symptoms were due to the ulcer which had not healed and to duodenal stasis which was not discovered at the time of the original operation. At the second operation, performed May 27, 1939, part of the pyloric stomach and the duodenal ulcer which penetrated into the pancreas were treated by the author's pyloroplastic closure. Since the acid values of the stomach were high, only very small part of the stomach as left and the operation as completed with typical Billroth II modification (Finsterer). The patient thus far has made good recovery. He still complains, however, of some diarrhea and palpitation after eating.

G. K., female, Case T-6504, operated upon July 8, 1937 for large penetrating ulcer of the duodenum. A Finsterer excision operation as performed. The patient was free from symptoms for short period of time and then began to complain of pain relieved only by food. X-ray examination and symptoms pointed to jejunal ulcer. Since this patient had large non-toxic goiter and parathyroid adenoma, she was operated upon June 30, 1941. A subtotal bilateral thyroidectomy as performed including the removal of parathyroid adenoma the size of hazelnut. The patient showed freedom from symptoms for several months and then gradually began to complain of pain which could be relieved only by morphine. She was operated upon November 6, 1940. A large jejunal ulcer penetrating into the posterior wall of the peritoneum as removed. The excised part of the stomach sutured to the duodenum as also removed. The duodenum as mobilized under the root of the mesentery on account of duodenal loops. The duodenal stump as closed. The proximal end of the jejunum as anastomosed to the distal end and to the side, and the open end of the proximal loop as brought out as temporary jejunostomy. The remaining proximal stomach as anastomosed to the ileo-cecal end of the duodenum. The patient thus far has made splendid recovery and up to date is completely free from her symptoms.

Summaries of 3 cases in which patients were combed.

M. Y. aged between 40 and 50 years, was operated upon in small private hospital for large bleeding ulcer on the posterior wall of the duodenum which had perforated into the pancreas. The ulcer as treated by the author's pyloroplastic closure with Finsterer's modification of the Billroth II. The patient expired 5 days after the operation. The postmortem examination revealed that the technical procedure as in good order. No blood was available for transfusion in that hospital and the after-care was not under my personal supervision.

M. H. R. Case number 8510, aged 60 years, operated upon because of bleeding gastric ulcer on the lesser curvature. At the operation it was found that there was also an ulcer in the duodenum. The patient had four transfusions before the operation on account of anemia. Finsterer's modification of the Billroth II as performed. The resection as used in this case on account of suspicion of malignancy. The patient made an uneventful recovery and on the day he was ready to go home, he expired suddenly. The postmortem examination revealed degeneration of the heart muscle with marked coronary sclerosis and thrombosis and occlusion of the coronary artery.

L. J., Case number A 851, male. This patient had violent hemorrhage and received seven transfusions during

his stay in the hospital. He was operated upon March 23, 1939. A large ulcer on the posterior wall of the duodenum was found penetrating into the pancreas with a narrow passage to the duodenum. A typical Finsterer exclusion operation with removal of the mucosa was performed. This patient lived only 2 days after operation. The postmortem examination revealed pancreatic necrosis and considerable bile stained fluid in the abdomen. In the attempt to palpate the ulcer the finger was thrust through the ulcer and the fragile posterior duodenal wall. This was not discovered during the operation on account of the posterior location of the ulcer and adhesions covering the ulcerated area. If the author's pyloroplastic closure had been used, the accident would have been discovered during the operation.

## SUMMARY

The technique of the Billroth II stomach resection is presented.

One hundred and seventeen primary stomach resections were performed with a mortality of 2.6 per cent. Every patient who succumbed to the operation came into the hospital on account of severe hemorrhage.

Technical errors and faulty pre operative and postoperative treatment are accountable for most of the fatalities.

The greatest number of gastrectomized patients are in excellent health. Those few patients who have not gained in weight and also those few who complain of mild dyspeptic symptoms all consider themselves cured of their original ulcers.

Thus far, there have been 3 definite failures. Two patients were operated upon for jejunal ulcers following the Finsterer exclusion operation with the mucosa left intact. A third patient who also had had the Finsterer exclusion operation performed developed a hemorrhage from the old duodenal ulcer. All 3 patients recovered from the secondary operations and are well at the present time.

The operation of gastric resection should become more popular provided that cases are carefully selected and that the knowledge and training of the surgeon are commensurate with the magnitude of such a procedure.

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# TECHNIQUE OF PARAVERTEBRAL ALCOHOL INJECTION

## Methods and Safeguards in Its Use in the Treatment of Angina Pectoris

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IN 1925 the Austrian surgeon, Felix Maudl, proposed paravertebral infiltration of procaine around the upper thoracic sympathetic ganglia for the relief of intractable angina pectoris. He claimed that procaine alone often sufficed to quiet the attacks over many days or even weeks. Unfortunately this long duration of relief has not been generally corroborated. A year after Maudl's article Swetlow demonstrated that procaine block could be safely supplemented with ethyl alcohol. The effectiveness of this method of treating the severest forms of angina pectoris has now been attested by a large number of favorable reports (6, 3, 6, 19, 23, 6). Since our first experience in 1927 85 paravertebral injections with alcohol have now been performed on 63 patients with various forms of medically intractable cardio-aortic pain, at the Massachusetts General Hospital. In 5 of these cases injection was performed by Dr W. J. Miller in the remainder by myself. As a result of observations made on this large series and the follow-up reports of patients after upper thoracic sympathectomy (24), we are now convinced that pain arising from all varieties of coronary and valvular disease as well as from syphilis of the aortic arch, will respond to either surgical or chemical destruction of the upper thoracic ganglia or the rami which join them with the heart and posterior spinal roots (Fig. 1). The reason why the results of these procedures are so far superior to the various forms of cervical sympathectomy is that all cervical operations fail to interrupt the direct thoracic cardiac nerves. These important accessory connections were first described a decade ago by Brauer in Germany, by Jonnesco and Enacheesco in Roumania, and in this country by Kuntz and Morehouse. The experiments of White Garvey and Atkins (15) showed that cardiac pain experimentally produced in dogs was not relieved by resection of the inferior cervical and first thoracic ganglia, but was no longer felt when the lower pathways were included.

Unfortunately most of the sufferers from severe coronary pain cannot safely be submitted to either

From Neurosurgical Service, Massachusetts General Hospital. After many attempts to procure alone 1 ka. never succeeded in stopping cardiac pain for from 4 to 5 hours, but after the period surgical attacks have recurred with their usual frequency.

a thoracic sympathectomy or a posterior rhizotomy. In order to help the majority of patients with advanced angina pectoris, it is therefore necessary to destroy these structures chemically by paravertebral infiltration. In our experience failure to relieve precordial and arm pain<sup>1</sup> by this method has never been encountered in the presence of signs of an effective paralysis of the upper thoracic sympathetic fibers, i. e. vasodilatation and sudomotor paralysis of the upper extremity and a Horner's sign. While mikos and piosis are desirable, as they indicate a thorough infiltration of alcohol well up along the lateral border of the first thoracic vertebra, the production of a Horner's sign is not essential for an effective block of the cardiac afferent fibers. The *slac qua non* is clear-cut paralysis of nerves to blood vessels and sweat glands of face, neck, and upper extremity.

Inasmuch as accurate paravertebral injection of alcohol is difficult and a number of serious complications have been reported to me from other clinics, it seems advisable to describe the technique of injection which has been evolved at the Massachusetts General Hospital during the past 15 years.

### TYPE OF PATIENT TO SELECT FOR INJECTION

Patients have been recommended for paravertebral injection by the cardiac consultants after thorough trial of medical treatment has failed to bring adequate relief of severe anginal pain. The only requisite has been really severe and frequent bouts of pain. No patient has been refused injection because of recent coronary infarction or threatened cardiac failure.

The etiological factor for the anginal attacks has included arteriosclerotic and hypertensive heart disease, syphilitic aortitis, rheumatic heart disease with aortic regurgitation ( ) and mitral stenosis. The oldest patient submitted to alcohol injection was 85 years old, the youngest 17. Twenty-six persons presented clear evidence of previous

One patient with reference of severe pain to the face, head, and neck has required secondary sections of the superior cervical ganglion.

In this series Table records show clear-cut Horner's sign in less than half of the patients injected. Yet all patients retained hot, dry hand and lasting relief of cardiac pain. If the hand became moist and cool again in course of few days, the attacks severely recurred.

coronary occlusion, and 18 suffered from angina decubitus

It has been our opinion that alcohol injection should be reserved exclusively for the poor risk patient with intolerable pain. With injection there is a 10 to 20 per cent chance of failure from lack of accurate infiltration, and about a 10 per cent chance of producing a troublesome chemical neuritis of the intercostal nerves. In the severe case neuritis is a minor matter in comparison with the relief of anginal pain, but the victim of milder attacks is less likely to tolerate the disagreeable neuritic sensations with equanimity. In general it may be stated that the severer the suffering and the poorer the operative risk, the more suitable is the patient for alcohol injection. If the less severe cases of angina pectoris are to be treated by cardiac denervation, it should be by actual operation.<sup>1</sup>

When patients with the most severe forms of angina pectoris are selected for operation, there is an appreciable danger in even such a minor procedure as paravertebral alcohol injection. Patients and their families should be warned of this before injection is undertaken. It has been our practice to state frankly that there are about 8 chances in 10 that the patient will have satisfactory relief from his cardiac pain. He should also be told that he is likely to have some transitory intercostal neuritis, and that there is 1 chance in 10 that it will bother him for several months. The risk of alcohol injection is far less than that of any other surgical procedure, but the technical difficulty of accurate injection prevents its being 100 per cent effective. If the injection fails to give sufficient relief, it can be repeated. As a final resort, the greater risk of surgical denervation may have to be faced in rare instances.

Finally, the physique of the patient makes a considerable difference in the ease of accurate injection. There should be very few failures in the thin-chested subjects with prominent spinous processes and transverse processes only a few centimeters beneath the skin. Here the needles need be inserted no more than 5 or 6 centimeters, but in the formerly heavily muscled and subsequently obese type exemplified by one ex-circus strong man, the needles may have to be thrust in to their entire length of 10 centimeters. It is well to select

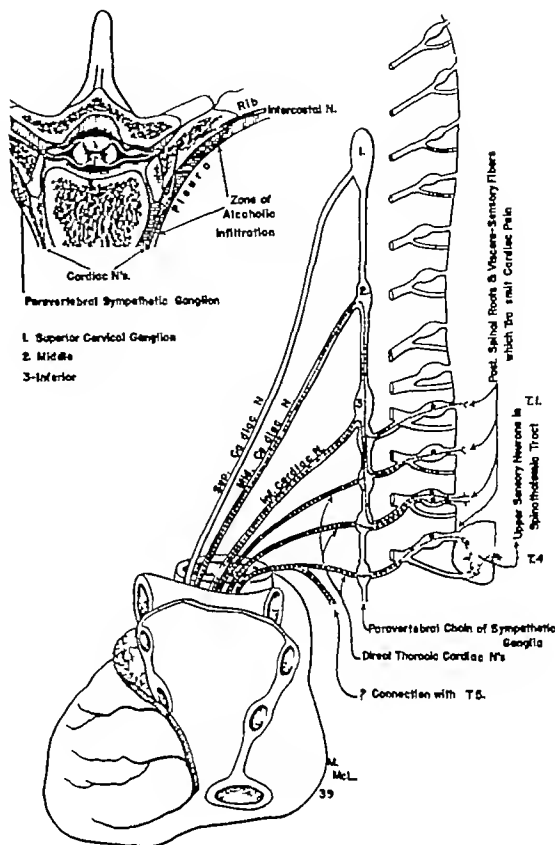


Fig 1 The sensory nerves of the heart. Afferent fibers from the vagus are not shown, because they play no rôle in cardiac pain. There are possibly afferent fibers in the superior cardiac nerve, but if present they must establish connections with the cranial and upper cervical nerves rather than descending in the cervical sympathetic trunk (see Davis and Pollock). Although a thoracic cardiac ramus is shown arising from the fourth thoracic ganglion, it is questionable how often it exists.

the former type for one's early attempts, but thereafter patients must be taken as they come, and the short-necked, stocky variety will unfortunately lower the record of successful results.

#### ARTICLES REQUIRED FOR INJECTION

Needles should be 10 centimeters long and constructed of rustless flexible steel. Thin lumbar puncture needles or the special Labat needles sold by the Anglo-French Drug Company of New York are most satisfactory. Each needle should be equipped with a depth marker to measure the distance it is to be pushed beneath the rib. A short length of narrow rubber tubing or a bit of bone wax serves this purpose well.

<sup>1</sup> Cervicothoracic operation is procedure of choice in this clinic for the patient who presents no unusual surgical risk provided he has a relatively normal electrocardiogram and is free from syphilitic or active rheumatic heart disease. I believe that resection of the inferior cervical first, second and third thoracic ganglia through an anterior supraclavicular incision is the most satisfactory procedure yet devised. This approach in which the anterior scalene muscle is divided was devised by Gask for sympathetic denervation of the arm in Raynaud's disease. It gives a distinctly better exposure and can be carried out more rapidly and with less risk to the patient than the posterior approach through the head of the first or second rib.

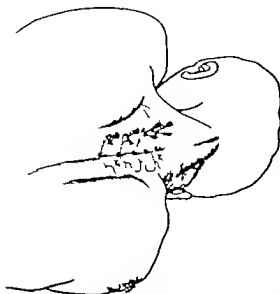


Fig. 2. Position of patient for paravertebral injection of the cardiac nerves. (From *Diseases of the Coronary Arteries and Cardiac Pain*, edited by Robert L. Levy Macmillan, New York, 1936.)

A hypodermic needle for raising cutaneous wheals at the points of insertion of the larger needles.

Any good 5 to 10 cubic centimeter glass syringe which fits the needles will serve for injection.

A local anesthetic.

Solution of 1 and 2 per cent procaine hydrochloride without epinephrine.

Ninety-five per cent or absolute ethyl alcohol (C.P.)

1 cubic centimeter ampoule of lidocaine.

#### TECHNIQUE OF INJECTION

Paravertebral injection is performed on the side of the severest pain and against the anterolateral borders of the upper thoracic vertebrae. In 76 per cent of our cases the pain has been largely on the left side; in 11 per cent predominantly on the right side and in 13 per cent it was bilateral. When bilateral injection should be done on both sides with a few days interval between. Whether more than the upper four thoracic ganglia and their rami ever require injection is not yet fully established, but it has been our practice to inject also beneath the fifth rib and occasionally beneath the sixth if the pain is referred to an unusually low level. If the attacks are very atypical, it is advisable to do a preliminary injection with procaine alone and then exercise the patient to the point which would previously have induced an attack. In the typical case, however, this preliminary test is unnecessary.

Alcohol injection for angina pectoris should be carried out with the patient in his own bed, and preferably in an operating room, although with the aid of a nurse it can be undertaken in the patient's home. Injection in bed is not difficult for the operator who is seated on a low stool and it enables the patient to be kept quietly on his side until the alcohol has been fixed in the tissues. The injection must be performed without a general anesthetic, because this masks the evidence of a successful placement of the needles. The patient must therefore be carefully medicated, in order to enable him to lie for an hour on his side with the minimal amount of discomfort and emotional strain. Having seen 2 patients die of coronary thrombosis a few hours before the time set for injection and 2 others develop infarction during the procedure, we have become sensitized to the danger of psychic strain in persons with severe forms of angina pectoris. Patients are therefore routinely given 3 grains (0.2 gram) of phenobarbital the evening before and this is repeated once or twice in the morning before the bed is moved to the operating room. This usually ensures a drowsy patient. In addition it has been shown by Weiss that the barbiturates reduce the chance of toxic reactions to procaine. It is also safer to order 1/100 grain (6 milligram) of atropine sulphate subcutaneously as a protection against syncope and other vagal reflexes. If on arrival in the operating room the patient is still restless and worried an additional 1/6 to 1/4 grain (10 to 15 milligrams) of morphine should be given before the needles are inserted. In any event morphine should be available in a syringe for immediate subcutaneous injection in case the patient develops severe pain during the course of the procedure.

The patient is laid on his side, upper back and shoulders close to the edge of the bed, legs drawn up, head flexed forward and supported on a thin pillow so that there is no lateral curvature of the cervical spine (Fig. 2). It is also important to make sure that the patient is not bearing too much weight on his lower arm, and to have both hands exposed so that they can be observed for changes in circulation and sweating.

The technique of inserting the needles is essentially LaBar's second method of paravertebral injection. The bony landmarks for insertion of the needles are the spinous processes. As these are imbricated downward like shingles on a roof, the first rib and transverse process lie lateral to the seventh cervical spine (the first prominent process). This relation holds over the upper thoracic vertebrae. Procaine is injected intradermally 4

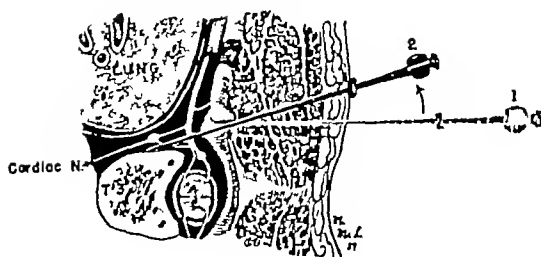


Fig 3 Insertion of needle for injection of cardiac nerves. 1, Needle inserted 4 centimeters to left of spinous process and tip in contact with transverse process of vertebra. Depth marker has been set at a point 3 centimeters from the skin. 2, Shank of needle has been rotated outward and tip worked inward until at an additional depth of 3 centimeters it lies in contact with the side of the vertebra and in close approximation with the ganglionated sympathetic chain.

centimeters lateral to the seventh cervical and upper three thoracic spinous processes.<sup>1</sup> The 10 centimeter needles (with depth markers on the shafts) are then inserted at these points and pushed inward perpendicularly to the skin until the transverse process or the articulating portion of the rib is touched at an average depth of from 2 to 5 centimeters (Fig 3, first position of needle). It is important to visualize the depth of the ribs in order not to penetrate the pleura and puncture the surface of the lung. If this happens, a spontaneous pneumothorax occasionally develops in the course of a few hours. Once contact has been made with bone, the tip of the needle is manipulated cradled until it touches the lower border of the transverse process. The depth marker is then pulled out to a distance of 3 centimeters from the skin. Each needle is now inclined to an angle of approximately 20 degrees with the median sagittal plane and perpendicular to the curvature of the back in relation to the long axis of the thorax. When thrust inward on this bearing a second contact is usually made with bone at a further depth of 3 centimeters (Fig 3, second position of needle). If sooner, the needle must be withdrawn and reinserted at a slightly lesser angle. On the other hand, if no contact is made at 5 centimeters the needle must be directed further toward the midline. The paravertebral ganglionated chains lie at an average depth of 3 centimeters beneath the transverse processes, running along the anterolateral surface of the vertebral bodies and looping over the heads of the ribs. The farther forward the tips of the needles can be inserted and still maintain their contact with bone, the less alcohol will come in contact with the inter-

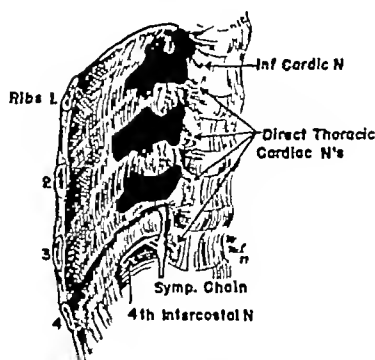


Fig 4 Distribution of 2 cubic centimeters of methylene blue injected in the manner described in the text against the sides of the upper three thoracic vertebrae in a cadaver. The dissection shows the way solutions diffuse in the retropleural plane around the sympathetic ganglia, communicant rami, cardiac, and intercostal nerves.

costal nerves and the greater amount will surround the gray visceral rami which run forward from the sympathetic trunk to the heart. A useful trick in working the tip of the needle forward alongside the vertebra is to start with the bevelled tip pointed medially. When bone is touched, the tip of the needle can often be made to scrape along it if the needle is rotated through 180 degrees so that its bevelled tip is turned away from the bone. A depth of even 4 centimeters beneath the transverse process is quite safe, provided the tip of the needle still rests against bone. An infiltration in this region will diffuse freely through the retropleural space, bathing the spinal nerves, the sympathetic trunk and its rami, and the cardiac nerves which run anteriorly in the posterior mediastinum (Fig 4).

In performing these injections, the needle should never be attached to the syringe. Care should be taken that the tip of a needle does not lie within the pleural space, in a blood vessel, or in an outward prolongation of the subarachnoid space. None of these eventualities is dangerous, provided it is recognized and the position of the needle corrected. With the tip touching bone, it is almost impossible for it to lie within the pleura. Rapid inspiration of procaine placed in the butt of the needle, or a cough reflex on injection, indicate that the tip lies within the pleural cavity. If it lies within a blood vessel or the subarachnoid space, aspiration of blood or spinal fluid will make these complications obvious. Bloody taps are frequent under the upper two ribs because the intercostal branch of the costocervical artery parallels the first and second thoracic ganglia. Spinal fluid is more rarely aspirated, but the possibility of a

<sup>1</sup> Following sterilization of the skin with tincture of iodine, acriflavine applied with a fine cotton applicator forms a jet black color and is an excellent medium for marking these points.



Fig. 5. This roentgenogram illustrates satisfactory position of an injection mass. After infiltration with procaine and alcohol, 3 cubic centimeters of lipiodol is injected through the uppermost and lowest of the four needles. There is good diffusion of the solution at the sides and in front of the bodies of the upper five thoracic vertebrae. A year and a half after injection this patient maintained complete freedom from his former severe attacks of right-sided angina pectoris.

high spinal injection of either procaine or alcohol to serious matter. This is most likely to happen if the needle is passed over the upper border of a rib in a cephalad direction. I have withdrawn spinal fluid twice and know of three instances of intrathecal injection of either procaine or alcohol. When all of the needles have been properly placed, they should form a characteristic pattern with their shafts lying in the same sagittal plane. The uppermost should be inserted deepest and point in a slightly more caudal direction than the others.

As soon as the needles are in position, 3 cubic centimeters of 1 per cent procaine should be injected into each. If properly placed, this minimal amount of solution produces clear-cut signs of intercostal and sympathetic nerve paralysis within a period of 5 to 10 minutes. Anesthesia appears in

the axilla and over the third and fourth ribs front and back. No anesthesia develops over the first and second ribs, as this area is also innervated by descending branches of the third and fourth cervical nerves. No anesthesia should develop in the arm or hand, but this entire region, as well as the side of the neck and face, should become hot and dry. This unilateral sympathetic paralysis is particularly striking when the hands are cold or sweaty from nervousness. Horner's syndrome is a less useful sign, as it is often hard to make out with the patient lying on his side and with the pupils constricted after morphine. When these signs appear rapidly it is good evidence that the needle tips lie close to the sympathetic trunk. If they fail to develop within 10 minutes it is best to withdraw the needles and reinsert them at a later time. It must be borne in mind that procaine diffuses through the tissues far more readily than does alcohol, and experience has shown that unless a clear-cut block can be produced by a minimal quantity there is no assurance of a lasting paralysis with 5 cubic centimeters of alcohol.

When satisfied that the needles have been placed correctly and that there is no anesthesia of the ulnar nerve or evidence of subarachnoid block, it is best to inject a further 3 cubic centimeters of 95 per cent alcohol into each. This supplementary infiltration is to ensure widespread anesthesia, so that the final injection of alcohol will be painless. The additional dilution of the alcohol does not seem to prevent an effective destruction of nerve tissue.

The final injection of 95 per cent alcohol is carried out very slowly—total of 3 cubic centimeters is injected through each needle—but the plunger is drawn back after each half centimeter has run in to make sure that the needle tip cannot have shifted and penetrated a blood vessel or the subarachnoid space. All together several minutes should be spent in injecting the alcohol through each needle. If the patient complains of any undue discomfort, the injection must be stopped for a few minutes until the pain subsides. By following the alcohol with a few drops of lipiodol, the exact location of each needle can be identified by subsequent anteroposterior and lateral spinal x-ray films (Fig. 5). This is of great value in developing the technical skill of the operator and in finding the cause of failures. Often it is found that the highest point of injection is alongside the second thoracic vertebra, but the nerves to the side of the first are by far the most important. In the thick-backed individual it is often difficult to

Five cubic centimeters of alcohol injected into the thick muscle of robust causes an area of necrosis little over 1 centimeter in diameter.

identify the first rib. As it is most undesirable to inject alcohol above it in the region of the brachial plexus, one is often forced to play safe and select the lower of two doubtful points. On several occasions when anginal attacks have persisted in the arm and under the upper sternum, subsequent x-ray films have shown no lipiodol above the second thoracic vertebra. This residual pain has disappeared after a more accurate injection under the first rib, made possible by x-ray localization.

After the needles have been withdrawn it is best to keep the patient on his side with his back supported by a pillow and as quiet as possible for an hour or more in order to minimize diffusion of the alcohol. He may then be shifted over onto his back, and after 2 hours allowed to assume any desired position in bed. Most patients can be up on the following day and leave the hospital within 72 hours.

#### COMPLICATIONS

The following early complications have been observed in this clinic.

Pleuritic pain has been troublesome in 4 patients within a few hours of the injection. This has appeared as the procaine has been absorbed, and it is surprising that it is not of more frequent occurrence. One, or at most two injections of morphine and chest strapping have invariably given satisfactory relief.

Severe pleuritic pain developed during injection in one case. This was probably caused by alcohol leaking into the pleural cavity. It necessitated large doses of morphine, but subsided within 6 hours.

Pneumonia followed injection in an 85 year old woman who was dying of coronary infarction. Injection in her case was undertaken because of the unusual intensity of pain, which had not yielded to large doses of opiates.

Pneumothorax has appeared within a few hours after injection in 2 patients. The cause of this is penetration of the pleura and puncture of the lung, so that air continues to leak from the injured alveoli for a number of hours. In one asthmatic patient aspiration was necessary for the relief of dyspnea.

Although no instance of intrathecal injection has occurred in this series, I have withdrawn spinal fluid on one occasion, and have always worried over the possibility of this most serious complication. The precautions which can be taken to avoid it are three. Never slide the needle over the upper border of a rib in a cephalad direction, always insert the needle detached from the syringe, and draw back on the plunger at frequent intervals during the actual injection. In spite of these pre-

cautions, a colleague has informed me that he has produced a high spinal anesthesia in the course of his preliminary procaine injection. However, if a volume of only 2 cubic centimeters of 2 per cent solution is used as a test for the position of each needle, the risk of injecting this small amount (40 milligrams) is practically negligible. Provided no abnormal anesthesia develops and the needles are not shifted, the danger of infiltrating alcohol intrathecally must indeed be very slight. Molitch and Wilson have recorded a Brown-Séquard paralysis, which came on almost immediately after a paravertebral injection of alcohol beneath the first rib. Fortunately the patient subsequently recovered from her paralysis and was relieved of her anginal pain. One other such accident has been reported to me. This also occurred following injection for angina pectoris, but no details are available.

Another serious early complication is coronary infarction. This has occurred twice in my experience during the course of injection with fatal results, and was probably the cause of an unexplained death which took place on the following day (see section on deaths to follow). As has been stated, similar accidents have resulted in 2 other patients a few hours before the time set for injection. John Hunter, an illustrious sufferer from anginal attacks, said that his life was in the hands of anyone who made him lose his temper. His sudden death, which took place after an argument at a medical meeting (9) bore out the truth of this remark. If serious coronary insufficiency in the form of either angina pectoris or coronary thrombosis can be precipitated by anger, it is equally likely to be brought on by the emotional strain of a surgical procedure. There is no way to predict this catastrophe, but much can be done to reduce its likelihood by careful preliminary medication, by doing injection with patient in his bed, and by taking care to avoid pain and emotional stimuli.

Late complications have been caused by intercostal irritation and neuritis. The sympathetic ganglia lie so close to the intercostal nerves that alcohol infiltrated around the chain cannot help bathing their trunks. They are paralyzed at first, but anesthesia begins to disappear in their anterior divisions within a fortnight. Within a month the intercostal nerves are recovering along their entire length, and with this there is a greater or lesser degree of hyperesthesia of the chest wall, which commonly persists for a number of months. Most patients state that pressure of clothing irritates the tender skin and that there is a burning sensation with occasional shooting pains. In most cases the discomfort is quite bearable and clears

up in a month or two. In others, about 10 per cent, it is more troublesome and requires mild sedation with acetyl salicylic acid or emprin compound, phenobarbital at night and occasional doses of codeine. Baking the hypernervous areas is often a great help. With the exception of a neurotic woman and one other individual in whom the injection failed to relieve the anginal attacks, the patients have all stated that they would willingly submit to a second injection if their attacks should ever recur.

There is no question but that neuritis constitutes serious objection to treatment by alcohol injection. In advanced coronary disease its disadvantages are far less than the risk of mortality from operation, but it prevents the application of the method in any but the severer cases of angina pectoris.

#### DEATHS

Five patients have died within 2 weeks of Injection.

**CASE 1.** An 85 year old woman, already moribund from coronary infarction, but with an extraordinary amount of precordial pain, was injected and her cardiac pain relieved. Three days later she died of pneumonia.

**CASE 2.** A 6 year old lawyer with generalized arteriosclerosis suffered from rapidly increasing number of attacks of typical angina pectoris—up to 10 in single night. Electrocardiogram shows abnormal T-waves in the first and fourth leads, consistent with coronary disease affecting chiefly the anterior surface of the left ventricle. After 3 weeks hospitalization without benefit from medical therapy, paravertebral injection was performed. Just as the infiltration of alcohol was completed he suffered syncope and attack. His fall in blood pressure to 40 millimeters systolic, and reduction in pulse rate from 80 to 60. His respiration nearly ceased. After oxygen inhalation and stimulating drugs the blood pressure slowly rose to 80/50 millimeters. On the succeeding days he developed fever of 38 degrees and leucocytosis of 24,600. During the next days he ran a slowly downhill course, with progressive heart failure and electrocardiographic changes typical of extensive coronary thrombosis. Postmortem examination revealed both old and recent infarction of the myocardium.

**CASE 3.** A 55 year old man gave history of angina pectoris for 3 years, on an intermittent basis. Two and half years previously he had had an attack of coronary thrombosis followed by bouts of cardiac pain of increasing frequency and severity. His pain was limited to the right precordium and arm. The electrocardiogram indicated the existence of coronary disease. Para vertebral injection was undertaken after he had failed to respond to medical treatment. The infiltration of alcohol was accomplished without any pain or other complication, but 30 minutes afterward his speech became confused and his color cyanotic. He rapidly lost consciousness. No pulse or heart sounds could be detected. Ten minutes later he was dead. Permission for an autopsy could not be obtained.

**CASE 4.** A woman of 56 with apical aortic atherosclerosis suffered from shortness of breath and attacks of substernal pain for 3 years. In spite of thorough antibiotic treatment her anginal attacks had increased in severity and frequency over the past 8 months. For 5 weeks she had been in bed with pain in the precordium and both arms, such as pre-

dictated by nervousness, eating, or the least exertion. Nitroglycerine produced an extremely unpleasant sense of fullness in her head. Her blood pressure was 150/90. There were definite enlargement of the heart, broadening of the aortic arch, dilated aorta, and signs of advanced aortic regurgitation without congestive failure. Para vertebral injection was done on the patient's left side in her home in distant city. The injection was carried out successfully and 3 hours later I left her in apparently unchanged condition. Her local doctor wrote that during the night she awoke sweating profusely and coughing. There was one attack of pain in her right chest, but none on the injected side. Cyanosis developed, with increasing shortness of breath and fading radial pulse. She died 30 hours after injection. No autopsy was done, but it seems most probable that her death was caused by painless coronary occlusion.

**CASE 5.** A fifth fatality occurred in a younger man of 36 with rheumatic heart disease. He suffered from angina pectoris described secondary to destruction of the aortic valve. In addition he had an enlarged heart, orthopnea, signs of mitral as well as aortic valvular disease, and evidence of acute rheumatic infection. Paravertebral injection was undertaken because he used up 100 nitroglycerine tablets each 24 hours and still failed to obtain adequate rest. He was felt that although he was distinctly poor risk his recovery was unlikely unless he could obtain relief from the constantly recurring attacks of pain in his left arm and precordium. Injection of alcohol was successful, but he complained afterwards of an unusual amount of chest pain, which required strapping and morphine. The pleuritic pain lasted 3 days, and although not very severe seemed to exhaust his remaining cardiac reserve and precipitate decompensation. His discomfort and the signs of decompensation seemed to improve, but he died on the tenth day.

His sudden cessation of the heart beat. Postmortem examination revealed moderate amount of free fluid in both pleural and pericardial cavities, but no evidence of any thrombosis or myocardial infarct. The usual local reaction to the injection of alcohol (edema and beginning fibrosis) was noted in the retropleural tissue around the upper thoracic sympathetic ganglia and these sized.

#### WHAT HAPPENS TO THE WARNING SIGNAL IN THE PATIENT WITH CORONARY DISEASE WHEN PAIN IS REMOVED

Sur James Mackenzie made the statement, so frequently quoted, that if the surgeon could remove the pain of angina pectoris it would be harmful because the patient would have no danger signal to warn him when he was overtaxing his heart. This prediction has fortunately not been borne out in our personal experience. We have seen number of patients after bilateral paravertebral injections who have had no residual pain but they have always known when they were having an attack. In the absence of anginal pain the warning signal has consisted of certain well defined symptoms such as dyspnea, palpitation, peculiar clutching sensation in the suprasternal

hole, an abnormal warning sign perceived after alcohol injection. This was always the case when patients had no such warning sign. Through the procedure mentioned and even to produce a warning sign that demonstrates, such as an sympathetic, before we realized we were developing an abnormal attack of paroxysmal dyspnea, we were never allowed to exert beyond his ordinary tolerance.

notch, or flushing of the skin. When the pain pathways have been interrupted on one side only, patients have often noted much milder, but typical attacks on the other side. To my knowledge there has been only a single case in which no warning signal has persisted after injection. This has been reported to me by the surgeon who performed the injection, and resulted in the death of the patient, who refused to limit his activity.

Far from being harmful, surgical relief of intolerable and frequent attacks of angina pectoris is often a life-saving procedure, a point emphasized in Miller's recent book on *Angina Pectoris*. This is especially true when recurrent nocturnal attacks prevent sleep. Two patients in this category were so worn out by lack of sleep that their attending physicians believed they were going to die of exhaustion. Both were relieved of pain by paravertebral injection. One lived for 5 years, until fatal decompensation followed his advancing syphilitic aortitis. The other, injected in a distant city, returned to his work as a storekeeper and remained well until an ill advised attempt was made to drain his chronically inflamed gall bladder 9 months later. This induced sudden death on the operating table. Numerous case histories could be cited in which the patients have been bed ridden for months on account of pain secondary to coronary thrombosis or aortic regurgitation with rheumatic fever. Relief of pain has enabled them to get out of bed and leave the hospital. One of the rheumatic group subsequently became self-supporting as a seamstress.

Although an adequate warning signal is nearly always preserved, patients must be warned that their cardiac reserve will not necessarily be increased. They must continue, therefore, to limit their activity to a level within the tolerance of their coronary circulation. Whatever they are doing must be stopped when telltale shortness of breath or any peculiar sensation develops, and they should continue to use nitrites as before injection.

#### DURATION OF RELIEF

That freedom from severe anginal pain may last indefinitely after paravertebral injection with alcohol is surprising, in view of the fact that after injection of the branches of the trigeminal nerve neuralgia is seldom relieved for more than 6 months. In this series complete interruption of pain has now lasted for over 2 years in 14 cases, and for more than 5 years in 3. One patient has remained over 90 per cent relieved of his former unbearable pain for 8 years. The reason for this long lasting paralysis of the cardiac pain fibers is explained by their anatomical structure. The

alcohol acts on the delicate rami which unite the sympathetic ganglia with the intercostal nerves dorsally and run ventrally as even more delicate strands to the heart. Whereas the white and gray rami are rarely larger than a millimeter or two in diameter, the cardiac branches are often no thicker than a hair. In addition, the sensory axones which they contain are protected by little or no myelin. They are therefore more easily penetrated by alcohol than the peripheral nerves, which are thicker and are covered by heavy sheaths of fibrous tissue. An alternative possibility is the fact that even the severest cases of angina pectoris may have spontaneous remissions. When this occurs a successful block, even if of short duration, may suffice to tide the patient over his period of intractable pain.

Return of troublesome paroxysmal pain after successful injection has been observed in only 5 of the patients in this series. In 2 the recurrent attacks have been so mild that they have been easily controlled by routine medical treatment. In only 3 have they recurred with their previous intensity after intervals of 3 years to 5 months. One of these has been submitted to a second injection. This patient, an unusual case in whom cardiac pain occurred during attacks of paroxysmal auricular fibrillation, has had a second recurrence of rapid irregular beats associated with the anginal pain. Repeated injections of alcohol seem to be less effective, due no doubt to the conversion of the loose retropleural areolar tissue into scar.

#### ANALYSIS OF STUDY

In this paper on the technical aspects of paravertebral alcohol injection for the relief of cardiac pain, there is no need to report the results achieved by the method in detail. This has been done in a number of previous articles (1, 23, 24, 26). To bring the series up to date the results are summarized in Table I. When allowance is made for the type of patient dealt with, it is evident that paravertebral alcohol injection, in comparison with surgical denervation, carries the minimal risk and with only a slight sacrifice in effective results. However, injection must be performed with the most scrupulous technique in order to place the alcohol with sufficient accuracy to ensure destruction of the sympathetic rami and the cardiac nerves. As mentioned, animal experiments have shown that 5 cubic centimeters of alcohol produces an area of necrosis not much over 1 centimeter in diameter. Observations made during two postmortem examinations have shown that this applies to man. The infiltration of alcohol must therefore be far more exact than when



TABLE 1—RESULTS IN 62 PATIENTS WITH  
INTRACTABLE ANGINA PECTORIS TREATED  
BY PARAVERTEBRAL ALCOHOL INJECTION

	Per Cent
Complete or nearly complete relief of pain	5
Reduction of severe attacks to mild form which can be treated satisfactorily by routine medication	30½
Unsatisfactory result	9½
Died within weeks of injection	5

One patient left for South Africa within 30 days of injection and has been lost track of. The others have been followed up or provide ranging from 3 weeks up to 3 years.

procaine is used as this drug diffuses so much more widely through the retropleural tissues. It is always evident when the alcohol has been correctly placed, because of the unequivocal signs of paralysis of the upper thoracic sympathetic ramus. When these signs persist, pain is just as effectively relieved as though the same structures had been resected.

Surgical resection of the inferior cervical and upper thoracic ganglia or posterior rhizotomy of the corresponding spinal nerves, are unquestionably better methods of dealing with cardiac pain than is paravertebral alcohol injection, provided the patient can tolerate an operation of such magnitude. Surgical denervation causes no neuritis and destruction of cardiac afferent pathways is nearly certain, but many of the severest sufferers from angina pectoris are impossible risks for surgery and even in the most carefully selected group there will be an occasional fatality.

In choosing between surgical and chemical denervation much depends on the training of the surgeon. Cutting the posterior spinal roots or cervicothoracic ganglionectomy falls within the routine operations performed by the neurosurgeon. But the technique of paravertebral alcohol injection is more difficult to learn and requires frequent repetition to perfect. It can be acquired by anyone experienced in the use of regional anesthesia by practice in the postmortem room with methylene blue (Fig. 4). Experience in human cases is most readily acquired by the use of paravertebral procaine block as a test for the degree of vasoconstrictor tone. This form of diagnostic injection described by Whit (2) may be used routinely in testing patients with Raynaud disease and thromboangiitis obliterans to determine whether the peripheral circulation can be improved by sympathectomy. In this way surgeons who are connected with a large clinic for the study of peripheral vascular disease can carry out paravertebral injection at frequent intervals. Satis-

factory results can be obtained in no other way nor can really serious complications be avoided. Blocking the cardiac nerves with alcohol should therefore not be attempted by anyone who has occasion to perform paravertebral injection only once or twice a year.

#### SUMMARY AND CONCLUSIONS

1. This paper describes the technique of paravertebral injection of the upper thoracic sympathetic ramus and the cardiac nerves in patients with intractable angina pectoris.
2. The value of chemical versus surgical destruction of the cardiac sensory nerves is compared.
3. It is concluded that in experienced hands paravertebral injection carries the minimal risk and is therefore applicable to the greatest number of patients who suffer most severely from cardiac pain.
4. Technical difficulties should prevent an effective destruction of the cardiac fibers in not more than 20 per cent of cases. Whenever there has been a persistent vasomotor and sudomotor paralysis, anginal pain has disappeared. The freedom from attacks is usually permanent, and the patients maintain an adequate warning signal.
5. The type of patient most suitable for injection, the dangers and complications which have been encountered are discussed. The chief of these is alcoholic neuritis of the intercostal nerves.
6. It must be reiterated that alcohol block of the cardiac nerves cannot be expected to give satisfactory results except in the hands of one who is willing to make a special study of its technique. This method should be reserved for patients with the severest forms of angina pectoris and degenerative changes of the coronary arteries. If surgical intervention is to be undertaken in less advanced cases it should be by open resection.

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# THE INTERLAMINAR REMOVAL OF PROTRUSIONS OF THE INTERVERTEBRAL DISC AT THE FOURTH AND FIFTH LUMBAR INTERSPACES

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PRIOR to the epochal paper of Barr, Hampton and Mixter establishing low back pain and sciatica due to protrusions of the intervertebral disc as a clinical entity, these lesions were removed as spinal canal tumors through the classical laminectomy. Familiarity with the surgery of any lesion leads to the simplification of surgical technique and several surgeons found it helpful to do hemilaminectomies in these cases instead of the more extensive laminectomy.

Most of these lesions occur at the fourth or fifth lumbar interspaces and the interlaminal spaces at these levels are larger than elsewhere in the spine. When the interlaminal space is large (Fig. 4) access may be had to the anterolateral aspect of the spinal canal simply by dissecting out the ligamentum flavum without the removal of bone (2). If the interlaminal space is smaller (Fig. 6a) it frequently is possible to remove the disc protrusion by enlarging the opening by nibbling away the edges of the adjoining laminae (Fig. 6b). This can be done most easily with a

small punch-like rongeur that bites at a right angle to its long axis, such as the Ferris-Smith modification of the Harrison rongeur forcep (3). In cases in which the laminae are further from the surface than usual and in which the interlaminal space is narrow (Fig. 5a) it may be necessary to remove adjoining portions of the spinous processes and laminae (Fig. 5b) to have access to the lesion.

For lesions at the fifth lumbar interspace it is our practice to make vertical skin incision from the fourth lumbar spinous process to a point just below that of the first sacral. The interspinous ligament is split between the fifth lumbar and first sacral spinous processes, the muscle is reflected with the periosteum from the spinous processes and laminae outward to the articulation and is held with a Hibbs retractor. The ligamentum flavum is dissected with a small periosteal elevator from the edges of the laminae and is removed with a pituitary rongeur. This exposes the dura, the nerve root and the lesion which can be seen or palpated with blunt in-



Fig. 4 Postoperative roentgenogram of spine from back disc protrusion as extracted without bone removal.  
Fig. 5 Postoperative roentgenogram showing bone defect (arrow) resulting from the piecemeal removal of

disc protrusion at the fourth lumbar interspace.

Fig. 6 Postoperative roentgenogram showing defect in lamina (arrow) and spinous process (dotted line) necessary for removal of protruded intervertebral disc.

Fig 4 A case in which removal of a disc protrusion is possible without the removal of bone

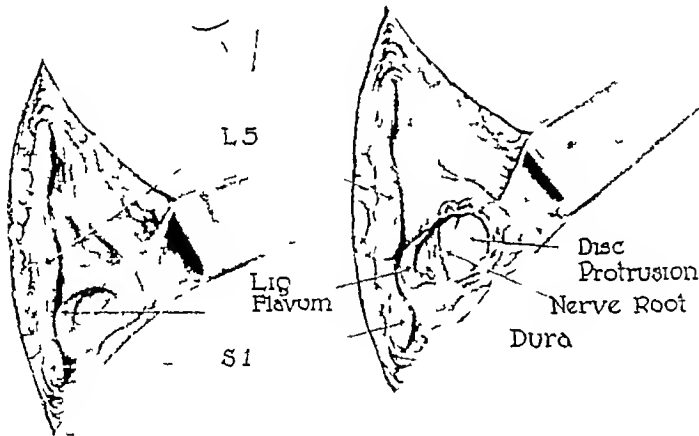
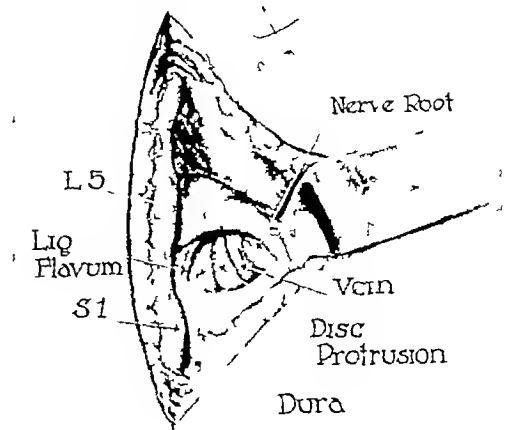
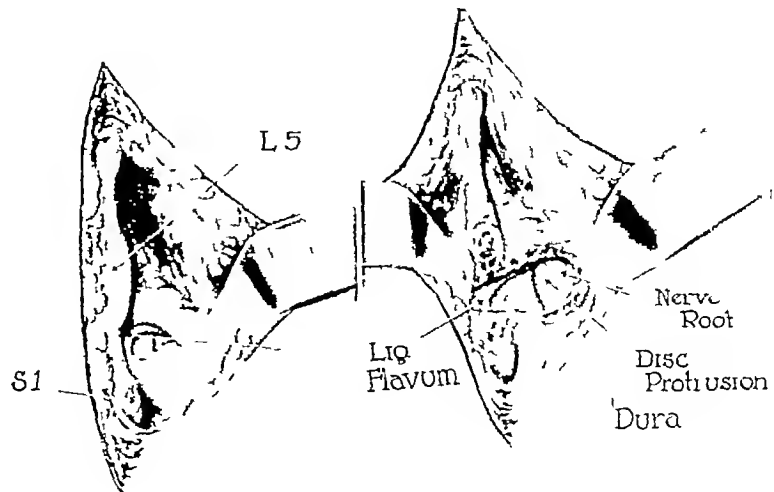


Fig 5 A laminal variant requiring a minimal removal of bone to allow extraction of a disc protrusion

Fig 6 Closely set massive spinous processes and laminae require the removal of more bone to allow access to the protruded disc



strument on the anterior surface of the canal. If necessary the edges of the laminae are nibbled away with the punch sufficiently to allow the nerve root to be retracted in the direction of least resistance. The dome of the mass, which still may be covered by the posterior spinal ligament, is incised and the mass is teased out with the pituitary rongeur. If lipiodol had been used for diagnosis, the dura and arachnoid are incised and the table is tilted head upward to allow the oil to drain out. The small incision is closed with one or two silk sutures on small curved needles. After perfect hemostasis has been obtained, the retractor is removed and the wound is closed in layers with interrupted silk sutures.

In most cases of protrusion of the intervertebral disc, these exposures are adequate time saving and not difficult. They conserve bone

and since a minimal amount of tissue is traumatized, the wound heals more quickly than in the case of laminectomy. If the lesion should prove to be not removable through so small an opening, the operation quickly can be converted into a hemilaminectomy or laminectomy. At other levels in the spinal canal where the interlaminar spaces are not so large more extensive removal of bone usually is necessary.

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# CANCER OF THE FLOOR OF THE MOUTH

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CANCER of the floor of the mouth is one of the more malignant but less frequent growths of the oral cavity. It is closely allied but not identical to cancer of the tongue, with which it is sometimes classified in the medical literature. In general, cancer of the floor of the mouth is unsuited to surgical removal and, when treated by radiation, may result in serious complications. Before the advent of modern radiation therapy, these difficulties caused this disease to bear an undeserved reputation for poor prognosis or even incurability. The present report is based upon an unselected and consecutive group of 103 cases of cancer of the floor of the mouth including all-comers in all stages of the disease who applied to the Memorial Hospital between the years 1930 and 1934, inclusive.

## DEFINITION

In the present report, the term "cancer of the floor of the mouth" designates those growths arising in that crescent shaped area which lies between the inner surface of the lower gum and the under surface of the tongue. In the literature this term has the sanction of long usage, although some writers include this group of tumors with "lingual cancer." Others separate "sublingual" or "infralingual" from "lingual" cancer, but do not specify a line of demarcation between the two. In some of these reports it is apparent that the term "sublingual" cancer refers both to growths of the floor of the mouth and to those of the undersurface of the tongue. From the practical standpoint, there is little advantage in grouping all tumors in these areas under one heading, and since each possesses distinct anatomical and clinical features and therapeutic indications, it is undoubtedly best to designate a specific group known as "cancer of the floor of the mouth," as described anatomically here.<sup>1</sup>

From the Memorial Hospital

<sup>1</sup>*Anatomy of the floor of the mouth.* Anatomists do not clearly define the limits of the floor of the mouth, although most of them at least mention the structure. By definition the tongue consists mainly of a muscular body covered by mucous membrane. On its under surface this mucous membrane is closely applied to the genioglossus and hyoglossus muscles and is then reflected from the surface of these muscles to pass over the floor of the mouth onto the inner surface of the lower gum anteriorly and laterally. The floor of the mouth therefore is a crescent shaped area bounded laterally and anteriorly by the inner surface of the lower alveolus, mesially by the reflection of the mucous membrane onto the muscular body of the tongue and ending posteriorly about on a line between the third molar tooth and the foliate papillae of the tongue (Fig. 1).

Beneath the floor of the mouth the submucosal space between the under surface of the tongue and the mandible contains loose areolar

## ETIOLOGY

*Incidence.* At the Memorial Hospital cancer of the floor of the mouth comprises 17 per cent of all intraoral tumors, 7 per cent of all cancer of the upper respiratory and alimentary tracts, and 1.43 per cent of all admissions for cancer. It is about half as frequent as cancer of the tongue. Duction reports 40 cases (0.42 per cent) in 9,504 cancer admissions to the Anti-Cancer Center in Toulouse, France. Fraser states that these growths make up 10 per cent of all intraoral cancer, and Stout found that 5 per cent of his series of intraoral cancer originated in this area. There are few reports in the literature on the relative incidence of cancer of the floor of the mouth, which many clinics apparently do not recognize as a separate anatomical entity but rather as a subgroup of cancer of the tongue or lower jaw. So far as we can learn, the term is not used in the average mortality statistics.

*Age.* In the series reported here, the average age was about 61 years, which is slightly higher than in lingual cancer (59 years) or intraoral cancer in general (about 57 years). Because the series is small, however, this slight variation may be only accidental. Schinz and Zuppinger found an average age of 55 years. The oldest patient in the present series was 89, the youngest 36. Only 10 per cent of the patients were under the age of 50, and over half were past 60. We have found practically no other specific references to age in the literature.

*Sex.* Cancer of the floor of the mouth appears to be more exclusively a disease of the male (98 per cent in our series) than does any other single

tissue in which lie several structures. The sublingual salivary glands lie immediately beneath the mucous membrane laterally, one on each side opening by 10 to 12 ducts along the longitudinal ridge known as the plica sublingualis. The submaxillary salivary ducts run forward mesial to the plica sublingualis to open near the midline, one on each side of the frenum. Posteriorly deep in the floor of the mouth there is a short forward projection of the submaxillary salivary gland which rests on the posterior edge of the mylohyoid muscle. These deep structures lie embedded in loose areolar tissue and are supported from below by the mylohyoid muscle laterally and the genioglossus anteriorly.

*Anatomy of the lymphatic drainage of the floor of the mouth.* From a consideration of the topography of the metastatic nodes which developed in the present series it seems probable that the nodes which serve as the first filter for the floor of the mouth are the prelingual and intracapsular nodes of the submaxillary group. The prevascular and retrovascular nodes in the upper posterior part of the submaxillary triangle are less often involved first than the aforementioned group. Contrary to what might be expected the submental nodes do not lie in the main drainage path from the floor of the mouth. Obviously, there are by passes into the upper deep and occasionally into the middle deep cervical groups of the jugular chain since metastases often appear first in these areas. In only one case in our series were the submental nodes involved first and it is hardly reasonable to believe that most submental nodes in cancer of the floor of the mouth occur by retrograde lymph flow from the submaxillary group.

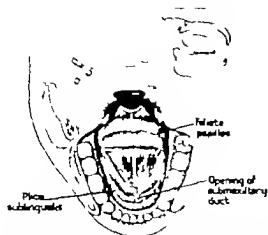


Fig. Anatomy of the floor of the mouth. The floor of the mouth is a crescent-shaped area bounded laterally and anteriorly by the inner surface of the lower gum, medially by the reflection of the mucous membrane onto the muscular body of the tongue, and ending posteriorly about one line between the third molar tooth and the foliate papillae of the tongue.

anatomical form of cancer which can develop in both sexes. Heretofore cancer of the lip (95 per cent in males) has commonly been regarded as the best example of unique male susceptibility. In the closely allied cancer of the tongue, only 85 per cent of the cases occur in males. Schlas and Zupping report a 90 per cent male incidence in cancer of the floor of the mouth, Golden 98 per cent, and Dracning found no females in his forty cases.

**Position of the growth.** Cancer of the floor of the mouth arises most frequently in the anterior portion to one side of the midline in close proximity to the opening of the submaxillary ducts. Although these growths seldom originate in the midline (3 per cent) they eventually cross the midline by direct extension in almost half of the cases. In the present series, few lesions developed in the middle third of the area. In about 15 per cent, the tumors originated posteriorly opposite the second or third molar.

**Causative factors.** Chronic irritation as predisposing factor is not so easily demonstrated in malignant tumors of the floor of the mouth as in cancer of the tongue or of the mucosa of the cheek. In the latter two anatomical sites, evidence of chronic glossitis, atrophy of the papillae or leucoplakia is found in a higher proportion of cases. From the anatomical standpoint it is obvious that the floor of the mouth is protected to a considerable degree from dental trauma and

from irritating contact with food and drink. Therefore chronic irritation in the floor of the mouth is most likely to be a part of generalized glossitis and stomatitis. Theoretically, at least, it is possible that some irritation in this dependent area can be caused by retention and fermentation of oral secretions and food particles. In examining the floor of the mouth, it is not uncommon to find 1 or 2 cubic centimeters of cloudy saliva containing debris of food and other foreign material.

An analysis of the best known forms of chronic irritation of the oral mucous membrane which occurred in the present series, will be discussed separately.

**Tobacco.** According to the case histories, 80 per cent of the patients admitted the use of tobacco usually smoking. In attempting to away the importance of this factor one meets the same difficulty as in other forms of intraoral cancer; that is about the same percentage of normal adults are addicted. So far as this series is concerned there is little evidence that cancer of the floor of the mouth arises frequently as the result of an excess of the tobacco habit.

**Chronic trauma from ill-fitting dentures.** It has been emphasized frequently that in many forms of intraoral cancer ill-fitting dentures are a responsible etiological factor a theory which is usually difficult to demonstrate in individual cases. It is obvious that when cancer arises in the oral cavity the patient, searching for some reasonable explanation, often ascribes the lesion to irritation from a denture which may have become ill-fitting because of the growth rather than vice versa. Such a tendency to ascribe cancerogenic capacities to alleged local trauma is common among both the laity and the medical profession in all forms of cancer. The fact that one event may appear to follow another is not always proof that the first is the cause and the second the effect. It will be found that most dentures become loose and ill-fitting after 4 or 5 years of use and that the average person continues to wear his dental plates for 15 to 20 years or even longer without change. If there were a frequent etiological connection, cancer of the floor of the mouth and of the gums should be much more frequent.

In this series, 29 per cent of the patients were completely edentulous, a not uncommon percent age in patients averaging 60 years of age and in only 3 cases (3 per cent of the total group) did the patients believe that a denture had caused irritation in the floor of the mouth.

**Syphilis.** In the present series, Wassermann tests were made in 69 cases and were positive in only 7 (10 per cent). This percentage of syphilis

is only about one-third that found in tongue cancer, but is nevertheless greater than the average incidence of syphilis in males of the corresponding age group—6 per cent—(26) It is probable, therefore, that syphilis plays a definite though minor rôle in the etiology of cancer of the floor of the mouth

*Leucoplakia* Leucoplakia, when widespread and generalized throughout the oral cavity, is frequently observed in the floor of the mouth, and was specifically noted in some portion of the oral cavity in 26 (25 per cent) of the present series This incidence is less than that found in cancer of the tongue (46 per cent) and of the cheek (70 per cent) These findings indicate that chronic irritation is probably a less prominent etiological factor in the floor of the mouth than in other forms of intraoral cancer

#### HISTOPATHOLOGY

In the floor of the mouth as in most parts of the oral cavity proper, the most frequent histological type of cancer is epidermoid carcinoma grade II (75 per cent) with grades I and III much less common Adenocarcinoma arising in minor salivary glands occasionally occurs (3 per cent) The radiosensitivity of the floor of the mouth cancer is higher than that of the anterior portion of the tongue or the mucosa of the cheeks and resembles that of the base of the tongue and pharynx As shown in a previous report (18), there is no adequate explanation of this fact from a histological standpoint.

#### SYMPTOMS, MORBID ANATOMY, AND CLINICAL COURSE

As in many other intraoral tumors, the most common first symptom in this disease is the patient's discovery of the lesion itself During mastication, the tip of the tongue is frequently inserted into the floor of the mouth The tactile sense of this portion of the tongue is very acute, and it is obvious that no irregularity of the oral mucous membrane which can be reached by this structure will long escape discovery In 10 of the present cases the first symptom noted by the patient was the appearance of a cervical node, and in these the primary lesion was discovered first by the examining physician at Memorial Hospital The primary lesion in the latter cases averaged 2.25 centimeters in diameter and was usually situated in the anterior one-third of the floor of the mouth

The symptom next in order of frequency is slight pain or tenderness, which is usually associated with infection of the growth and, therefore,

seldom occurs in the earlier lesions When pain or tenderness is given as the first symptom, the lesion is usually fairly well advanced, and upon closer questioning the patient will, as a rule, admit that he has been aware previously of an irregularity in the floor of the mouth

The earliest lesions in this series consisted of superficial deep red, slightly ulcerated plaques about 5 millimeters in diameter, infiltrating the mucous membrane In all of these early lesions the complaint was of "soreness" in the floor of the mouth, and the patients were of the apprehensive intelligent type It is probable, however, that only a small percentage of the growths begin in this manner, since in the present series the average diameter of the growth on admission was a little over 2.5 centimeters and the average duration of symptoms was about 7 months, indicating that pain or tenderness had neither been an early nor a marked symptom

When the growth reaches a size of about 1 centimeter, it tends to fungate out from the mucous membrane, to form an irregular, nodular, sometimes slightly pedunculated, ulcerated tumor which may spread either posteriorly onto the undersurface of the tongue or anteriolaterally onto the inner surface of the alveolus (Fig 2) In other instances, the lesion may deeply invade the floor of the mouth, to penetrate the subcutaneous tissue in the submental region, sometimes simulating metastases to the submental lymph nodes (Fig 3) Such deep invasion is usually accompanied by obstruction to the submaxillary duct, so that there is associated swelling and tenderness of the submaxillary gland on the involved side (Fig 4) Invasion of the sublingual salivary gland appears to cause no specific symptoms In advanced cases, there is usually extension into all of these structures The tongue, when deeply invaded, becomes fixed, surface necrosis occurs with sepsis, and pain and salivation due to the inability to swallow become prominent symptoms

With deep invasion of the tongue and floor of the mouth, the growth becomes fissured with localized cellulitis Surface necrosis may develop, accompanied by pain on movement of the tongue or on swallowing Dysphagia results in profuse salivation With deep erosion, hemorrhage frequently occurs from the lingual arteries, and the trauma incident to local tamponage in an effort to control the hemorrhage results in increased necrosis and extension of the sepsis These complications combine to produce malnutrition and cachexia, and when the disease is uncontrolled locally, death occurs in most cases before the cervical or visceral metastases become prominent





Fig. 2 Patients with cancer of the floor of the mouth are fortunate if they happen to be edentulous at the beginning. The absence of teeth facilitates the accurate centering of the peroral cylinder for radiation of the floor of the mouth. The laceration of the gums following extraction of the teeth markedly increases the danger of such later complications as osteomyelitis. At left, cancer of the floor of the mouth of months' duration. Diagrammatic insert shows extent of lesion. The healed condition after treatment by combination of radiation and radon seeds is shown at right. Patient has remained well for years.

**Metastases** Although cancer of the floor of the mouth is considered by all writers on this subject to be a highly malignant form of oral cancer, a statistical analysis of the metastases in the present series does not indicate that the malignancy of this disease depends upon an early or unusual capacity to metastasize. In the present series, 35 (34 per cent) had metastases on admission which, although more than the figure in a recently analyzed series of cancer of the lip (24 per cent) is a little less than in cancer of the tongue (39 per cent). After admission, an additional 24 per cent developed metastases, so that a total of 58 per cent had metastases at some time during the course of the disease, which is about the same as in cancer of the tongue (62 per cent).

In the present floor of the mouth series, the first lymph node involved was in the submandibular group (about 66 per cent of those cases which

metastasized). In 16 per cent the first node involved was the upper deep cervical group of the jugular chain. Contrary to what one might expect, the submental lymph nodes are not in the direct path of the main lymphatic drainage from the floor of the mouth and in the present series they were involved first in only one case. As previously mentioned, with deep extension the growth may invade the subcutaneous tissue in the submental region, stimulating metastasis to this area. After initial involvement of the submandibular lymph nodes, the disease in most cases extends to the jugular chain and progresses downward to involve the supraclavicular nodes. In one case in the present series, the first node involved was in the middle of the jugular chain.

In the autopsy records at the Memorial Hospital there are 2 cases of cancer of the floor of the mouth and in only 1 were visceral metastases



Fig. 3 At left, moderately advanced cancer of the floor of the mouth extending to but not beyond the midline. Diagrammatic insert shows extent of lesion. The presence of teeth in the lower jaw renders treatment more difficult. In the large case it is better to extract them before treatment is begun. At right, healed condition after treatment by peroral radiation and radon seeds. Patient has remained well for years.

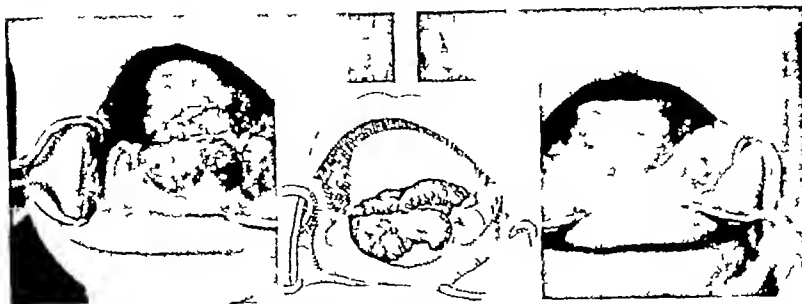


Fig 4 At left, advanced cancer of the floor of the mouth involving the adjacent gum margin. Diagrammatic insert shows extent of lesion. At right, healed condition following treatment by x radiation and radon seeds. Patient has remained free of disease for 7 years.

found—liver and lungs. This finding is based on too small a number of cases to be considered conclusive and it may be only coincidental, since at the Memorial Hospital visceral metastases have been found in 29 per cent of patients dead of cancer of the lip and in 40 per cent of those dead of cancer of the tongue. There is no logical explanation for this discrepancy. Dorrance, reporting on both floor of the mouth and lingual cancer, states that in 15 autopsies he found no visceral metastases.

#### DIAGNOSIS

As in all forms of cancer, a biopsy is essential in the diagnosis of suspected malignant tumors of the floor of the mouth. Furthermore, histological examination is essential as a matter of record in any series subjected to statistical analysis.

*Delay in diagnosis.* In the present series there was an average delay of 5 months between the first symptom and the establishment of a definite diagnosis. The significance of delay in diagnosis is shown by comparison with other forms of intra-oral cancer recently analyzed at Memorial Hospital (17, 19). In a series of cancer of the tongue the interval was about the same, indicating that the severity of the symptoms and the progression of these two diseases is probably about the same. In cancer of the lip there was an interval of about 15 months between the first symptom and admission for treatment, indicating a much more benign and slower clinical course. In few of the cases of cancer of the floor of the mouth was the delay due to procrastination by the medical or dental profession. Three patients were treated by dentists and had teeth extracted under a diagnosis of dental irritation. Three patients had surgical or radiological treatment in other clinics for cervical metastases without discovery of the primary lesion. Two patients had been reassured by a

physician that the disease was inflammatory and were told to use antiseptics. In one instance antiluetic treatment had been given over a period of several months under a diagnosis of syphilis, because of a positive Wassermann test.

*Differential diagnosis.* The differential diagnosis of cancer of the floor of the mouth should not be difficult, since benign ulcerated lesions are extremely rare in this area. A calculus in the submaxillary salivary tract, although producing an indurated palpable mass, should be readily differentiated. The so called "ranula," which is a dilatation of a minor salivary gland and not, as is commonly supposed, a distention due to blockage of the submaxillary salivary duct, should never be confused with cancer. Single herpetic lesions may occur in the floor of the mouth, but may be easily differentiated from cancer by a history of sudden onset with pain and tenderness and the characteristic punched-out appearance of the ulcer. If associated with herpes elsewhere in the oral mucous membrane, the diagnosis is simple. Such chronic and asymptomatic lesions as leucoplacia, hemangioma, and xanthoma should be diagnosed without difficulty.

In dietary deficiencies, especially those due to avitaminosis B, the floor of the mouth is often the site of a subacute inflammation, deep red and sharply delimited in character, which may closely resemble early cancer. In this condition there will usually be an associated mucositis of the tongue as well as radial fissures in the skin at the labial commissures, which indicate the true nature of the disturbance.

#### GENERAL PRINCIPLES IN TREATMENT OF CANCER OF THE FLOOR OF THE MOUTH

Only early growths of the floor of the mouth not much over 1 centimeter in diameter can be removed surgically even by extensive and locally



Fig. 5. Peroral radiation for cancer of the floor of the mouth. With the mouth opened as widely as possible the floor of the mouth can be exposed for peroral radiation by the introduction of cylinder 5 to 4 centimeters in diameter. The large cylinders can be used only in the absence of the anterior teeth in the upper and lower jaw. The extraction of even sound teeth is justified, when necessary to facilitate such procedures.

deforming operations. The larger lesions (the average diameter on admission is a little over 2.5 centimeters) are inoperable from the practical standpoint except by resection of the anterior parts of both the tongue and the mandible. The inoperability of the average case of cancer of the floor of the mouth is admitted by most writers. Among authors who definitely express opinions on this subject, only McMillan and Morestin recommend surgery and the latter wrote before the advent of modern radiation therapy. Most other authors (2, 6, 11, 13, 14, 22) recommend radiation or combination of radiation and sur-

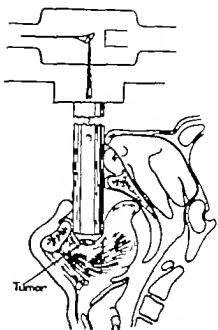
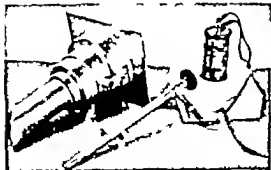


Fig. 5a. Diagram showing application of apparatus.

gery with a small number (1, 3, 6, 24) expressing a preference for the cautery or electrocoagulation. Even in the smaller growths, surgical excision necessitates stripping the soft tissues, including periosteum, from the inner surface of the mandible and the removal of the mucous membrane from the under surface of the tongue. Healing of such a wound necessitates approximation of the exposed cortex of the mandible and the wound can contract only by pulling the tip of the tongue down.



b

Fig. 6. Periscope. a, Master head with 4 centimeter peroral cylinder attached; b, electrically lighted periscope; c, physician checking centering of peroral



portal by electrically lighted periscope before beginning the irradiation.

into the floor of the mouth, where it becomes fixed to the mandible and practically immobile. If surgical removal were the only form of treatment available, and if it could be successfully applied in a fair percentage of cases, such post-operative defects and deformities would certainly be justified in so malignant a disease as cancer of the floor of the mouth. It must be admitted, however, that a relatively small percentage of cases are operable when first seen, that radiation therapy (either curative or palliative) is applicable in all cases, and that properly applied modern radiation therapy in all comers will produce a higher cure rate than surgery used only in the early and operable cases. It is significant that those authors who recommend surgical excision or endothermy as being superior to radiation therapy make no report on 5-year cures (McKillop, Bloodgood).

Radiation therapy of cancer of the floor of the mouth was formerly given either by interstitial implantation alone or externally through portals directed horizontally through the ramus of the mandible and vertically, from below, through the submental region. Such treatment was ordinarily supplemented by interstitial radon. Following radiation under such plans, the incidence of localized radionecrosis of soft tissue and bone was comparatively high. A more recent development is the use of peroral x-radiation (16) given through the open mouth with cylinders centered directly over the lesion itself. When supplemented by radon seeds, the intense radiation dose may thereby be confined to the growth and the immediately adjacent tissues, sparing the outlying normal tissue (especially the mandible), and the incidence of untoward sequelae can be markedly reduced. There can be little question but that radiation given by the technique described below is the best so far developed in the treatment of cancer of the floor of the mouth.

*General hygienic measures.* Cancer of the floor of the mouth is commonly associated with a marked degree of local infection, especially when the lesion is deeply fissured, and in any case sepsis usually occurs as a complication of treatment. If teeth are present, they always interfere with treatment and lead to dental complications following radiation. The patient with cancer of the floor of the mouth is indeed fortunate if he happens to be edentulous at the beginning. Both upper and lower teeth anteriorly interfere with the proper insertion and direction of the peroral cylinder, and it is usually necessary to extract or cut them off before treatment. Even if the teeth are perfectly sound, such measures are justified. Healthy teeth

may be cut off at the gum level, and the root canals filled so that later dental restorations may be made. There are other reasons for cutting off the teeth rather than extracting them, as will be discussed further under complications. In all cases before beginning treatment, all the teeth should be thoroughly cleaned by a dentist and the patient instructed in the proper use of a tooth brush.

During radiation treatment and until healing is complete, the patient should be instructed to irrigate the mouth with large quantities of warm alkaline-saline solution (1 quart of water with 1 dram each of sodium bicarbonate and sodium chloride). Since the local area becomes tender and painful during the radiation reaction, the taking of food is usually uncomfortable and even painful. The patients must therefore be instructed in the form and nature of a satisfactory diet. In many cases, it must be liquid or at least soft, and directions should be given for the preparation of a properly balanced diet. During recent years it has become more and more evident in the clinic at the Memorial Hospital that a large percentage of intraoral cancers, especially those of the tongue and floor of the mouth, are associated with a chronic glossitis, usually related to some dietary deficiency or avitaminosis. If the diet becomes further restricted due to local discomfort, this dietary deficiency is accentuated. We have found that the local condition and the maintenance of the patient's general health during treatment and recovery is greatly favored by the administration of large quantities of vitamins, the most necessary being the B complex and, though of lesser importance, vitamin C. In the most marked dietary deficiencies, liver is required in the form of liver extract powder in doses of at least 1 teaspoonful, three times a day, dissolved in about 8 ounces of hot water and taken as a bouillon. In lesser degrees of deficiency or during convalescence, this therapy may be given in the form of dried yeast, one heaping tablespoonful three times a day. If the patient cannot tolerate either liver extract or yeast by mouth, or if either is found to be difficult to administer because of local tenderness, then extracts of these substances can be given intramuscularly.

In our clinic all patients attend what is known as the "Clean-Up Clinic" daily during the administration of the fractionated x-radiation and until the reaction has completely healed. At this time the local area is cleansed with a power spray of an alkaline solution or Dakin's solution, and any other deficiency in the patient's hygienic or dietary regimen is corrected.

#### TREATMENT OF THE PRIMARY LESION IN CANCER OF THE FLOOR OF THE MOUTH

The treatment of cancer of the floor of the mouth by radiation is so far superior to surgical removal that the latter does not merit any detailed discussion. Most surgeons strip the perosteum from the adjacent inner cortex of the mandible, widely and deeply excise the primary lesion and the adjacent mucous membrane and muscle of the under surface of the tongue. The wounds are left open to heal by granulation. Cautey or endothermy methods alone are probably even less desirable forms of therapy in this area. Radiation therapy is undoubtedly best given in the form of fractionated peroral x-radiation through rather narrow portals, supplemented in most instances by radon seeds implanted directly into the growth.

*Technique of treatment by peroral x-radiation.* In deciding upon the exact factors for peroral x-radiation in this area the mouth should be opened as widely as possible and the growth visualized through simple cylinders of various diameters. The size, shape, and exact direction of the proper cylinder should be selected so as to expose the primary lesion adequately at an angle of approximately 90 degrees to the incident beam. The diameter of the portal depends to a large extent upon the size of the primary lesion. Only in the smaller growths, with a diameter of 1 centimeter or less, should portals as small as 1.5 centimeters be used, and these can be employed safely only if special attention is given to accurate centering. If there is any question in this regard, the portal had best be at least 3 centimeters or larger in diameter but it is seldom feasible to give peroral x-radiation to the floor of the mouth through portals larger than 4 centimeters. The detailed technique of peroral x-radiation has been described in a previous report (16).

The patient may be seated in a chair with a head rest, or he may be on a table with the head propped up by pillows as in Figure 5. The cylinders should be inserted so as to hold the tip of the tongue folded upward and backward. The accurate centering of the peroral cylinders is best checked by a lighted periscope device as illustrated in Figure 6. Since most of these lesions are at the surface, target skin distance of 35 centimeters or even less is to be preferred with the other physical factors about as follows: 200 kilovolts, 5 to 30 milliamperes, filter 0.5 millimeter copper plus 1 millimeter aluminum. The dosage must vary with the size of the portal. Treatment may be given either daily or as a matter of convenience—to patients who live at a considerable distance—every other day or three times a week.

The dose of the individual treatment should be adjusted so as to deliver total of 5,000 to 7,000 r in 20 days with portals 4 to 5 centimeters in diameter. In the average case the treatment should be outlined so as to deliver a specified total dose in a period of about 3 weeks, after the completion of which the decision as to the necessity for supplementary treatment by either additional peroral x-radiation or radon seeds must be made empirically on the basis of the intensity of the local reaction and the degree of regression of the primary lesion.

*Technique of supplementary treatment by radon seeds.* During the course or immediately following the completion of fractionated x-radiation, radon seeds in small, sometimes divided, doses can usually be employed to advantage in the floor of the mouth. The dosage is empiric and can be learned only by experience. The strength of the individual seeds should be small (1 to 1.5 millicuries) and they should be placed, if possible, over 1 centimeter apart. The total dose need seldom be over 5 to 6 millicuries in the average case and can often be cut down to 2 to 3 millicuries. In most clinics the treatment of cancer of the floor of the mouth was formerly carried out almost entirely by the interstitial implantation of radon seeds or needles, and even today such therapy is recommended by some authors. This method is attended by an unnecessarily high incidence of local radionecrosis and osteomyelitis, complications which are particularly serious in the floor of the mouth. By combination of peroral x-radiation and radon seeds, the frequency of these complications can be greatly reduced and it is our opinion that interstitial radon alone should now be discarded as a method for the treatment of cancer in this location.

#### TREATMENT OF METASTASES IN CANCER OF THE FLOOR OF THE MOUTH

The problem in the treatment of cervical metastases in cancer of the floor of the mouth resembles that in cancer of the tongue. If all cases are considered, it will be found that neck dissection is not suitable in the majority the main reason being that if the growth in the floor of the mouth is extensive requiring long convalescence after treatment, or if metastases are present on admission even with a small primary lesion, neck dissection cannot be carried out with safety in conjunction with aggressive treatment of the primary lesion. One solution of this difficulty is the treatment of the metastases as well as the primary by radiation. The choice between neck dissection and radiation for the treatment of late

metastases—those which appear clinically after healing of the primary lesion—is optional and may be made on the basis of the available equipment and the experience of the surgeon with the various methods. In the average favorable case of metastases following complete healing of the primary lesion, it is probable that radiation is at least as successful as neck dissection.

*Radiation treatment of metastases* If the nodes occur in the submental or suprahyoid regions, it must be realized that aggressive treatment by irradiation of both the primary lesion and the metastases is apt to be more than the local tissues can tolerate. Deep necrosis with perforation from the floor of the mouth through the submental region is therefore not an infrequent complication, especially if the inner surface of the mandibular arch has been exposed so as to produce osteomyelitis and sequestration of bone in this region. A partial solution of such a difficulty is the use of accurately centered small portals and accurately placed radon seeds both in the primary lesion and the cervical nodes. So far as the cervical nodes are concerned, this end is best accomplished by  $\gamma$ -radiation given through small portals limited to the region of the node itself with a margin of not more than 1.5 to 2 centimeters giving total doses of 5,000 to 7,000 r in fractions, supplemented by small doses of radon seeds as in the treatment of the primary lesion. Such treatment can be given to each of several widely separated nodes. The exact technique as used at the Memorial Hospital includes (a) histological proof of the malignant character of the node by aspiration biopsy, (b) the accurate marking of the skin by tattooing directly over the center of the node, (c) the selection of the proper sized portals (3 to 5 centimeters in diameter, and (d) supplementary radon seeds, often in fractionated doses. Treatment by fractionated  $\gamma$ -radiation is given either daily or three times a week, and the individual dose so selected as to reach a total dose of 6,000 to 8,000 r in a period of 3 weeks, after which a dose of 5 to 6 skin erythema doses seeds is implanted either through the skin or directly into the node after surgical exposure.

In the present series, 6 cases of cervical metastases proved by aspiration biopsy have remained free of recurrence 5 years following treatment by radiation. There are 3 additional successful cases in which, unfortunately, the histological confirmation of the clinically positive nodes was omitted. All cervical metastases not treated surgically, including the hopelessly advanced, were treated by radiation, and therefore calculations as to the percentage of successes by this method could not

be fairly compared to the early and favorable cases treated by surgery.

*Neck dissection* Neck dissection in cancer of the floor of the mouth is of limited value. Since the primary lesion usually crosses the midline, either or both sides of the neck may be involved. When metastases occur, they do not long remain directly in the submaxillary or submental regions. A bilateral dissection of these areas is not sufficient, and routine block dissection of both sides of the neck is obviously injudicious. From the practical standpoint, neck dissection should be considered only in those isolated cases in which metastases first appear after complete healing of the primary lesion. Neck dissection when done in these cases should extend from the lower border of the mandible and include the whole cervical region from the midline to the anterior border of the trapezius down to the clavicle. In the submental area the dissection should be wider to the opposite side than in cancer of the lateral border of the tongue, and therefore the operation must obviously be a great deal more extensive than for metastases of the lip.

In the present series, 8 patients with cervical metastases were treated by neck dissection, of which all but one showed histologically positive nodes. Of the histologically positive group, 4, or 57 per cent, remained free of disease for 5 years or more.

#### COMPLICATIONS

*Pain* In the absence of deep invasion with radionecrosis, the pain incident to the treatment of floor of the mouth cancer can usually be adequately controlled by mild narcotics, such as codeine and acetyl salicylic acid. Proper attention to the local hygiene is of great assistance in this regard. When radionecrosis with osteomyelitis occurs, the local pain is often so severe as to be incapable of satisfactory relief by either local cleansing measures or narcotics. This area is supplied entirely by the third divisions of the fifth cranial nerves, and there is no anatomical form of cancer in which neurolysis by alcohol injection is more efficacious. The injections for this purpose should be made externally below the zygoma because, unfortunately, neither the lingual nor the inferior dental nerves can be satisfactorily approached through the mouth for alcoholic injection. The detailed technique for these procedures has been described by several authors (10, 13, 15).

*Radionecrosis and sepsis* These complications occur most often when the  $\gamma$ -radiation is given through the skin of the chin and submental regions or when interstitial radon is employed in

heavy damage. Many years ago Quick called attention to the high incidence of radionecrosis when seeds alone were used in the floor of the mouth. Although the incidence and extent of radionecrosis is greatly reduced by the use of peroral rather than external skin portals, this complication in the larger lesions (over 3 centimeters in diameter) cannot be entirely eliminated even by the most carefully and efficiently administered peroral x-radiation and the minimal supplementary dose of seeds.

Due to the dependent position of the lesion in the floor of the mouth adequate drainage is difficult, and there always remains a pool of saliva and debris in which bacteria may flourish. One of the best means of overcoming this difficulty is frequent irrigation and cleansing of the area by a power spray. The bacterial flora in necrotic lesions of the oral cavity is mainly asphytic and anaerobic in character and amenable to at least partial control by the application of oxygenic substances. Sodium perborate in solution was formerly used with some success, but a much more efficacious method has recently been developed by Meleney. Zinc peroxide when activated by autoclaving to 140 degrees for 1 hour and made into a thick suspension to saturate gauze packing, gives off nascent oxygen for periods of 18 to 24 hours. When a necrotic, foul-smelling ulcer so typical of radionecrosis is treated by the application of zinc peroxide on gauze, the odor will usually disappear within an hour or two and if the slough can be removed, the borders of the lesion assume a pink improved appearance with the complete disappearance of the odor. In most intraloral lesions there appears to be a symbiosis between asphytes and the ordinary pyogenic organisms. If the anaerobic asphytes can be eliminated, the normal tissues apparently can soon overcome the pyogens.

**Hemorrhage.** This complication occurs frequently when there is radionecrosis in the floor of the mouth. The lingual artery enters the tongue on its under surface medial to the hyoglossus muscle and runs forward as the lingua profunda toward the tip of the tongue nearer the under surface than the dorsum. The floor of the mouth is supplied by the branches of the profunda. None of these branches is large enough to be the cause of profuse hemorrhage by itself but if the necrosis extends deeply and backward toward the under surface of the tongue the profunda itself may be eroded, and serious hemorrhage may occur. The only immediate method of control is by tamponage which unfortunately always produces serious trauma and increases the radio-

necrosis, especially when the tamponage even though well intentioned, is so energetic as to strip the soft tissues from the inner surface of the mandible. After immediate control by packing the next step should be ligation of one or both lingual arteries, depending on the extent of the necrotic area. If the radionecrosis crosses the midline, both arteries should be ligated. The surgical exposure for the lingual artery is best accomplished by an incision along the upper anterior border of the sternomastoid muscle, the center of the incision being about 1 centimeter below the angle of the jaw. The anterior edge of the sternomastoid and the jugular vein are retracted posteriorly and the carotid bulb exposed by blunt dissection. The lingual artery is the first branch of the external carotid; it turns upward above the superior thyroid branch, which curves downward. Unless there is very deep back and extension of the necrosis, ligation of the lingual artery alone is sufficient. In order to prevent recanalization, the artery should be divided between ligatures in all cases.

**Osteomyelitis.** This complication is most likely to occur when unnecessarily large portals have been used for x-radiation and especially when this radiation is given from the outside so as to devitalize the bone of the mandibular arch. When small portals are used perorally and unnecessary radiation to the mandibular arch is avoided and when the dose of radon seeds is kept to the minimum osteomyelitis is seldom a serious complication. All bone which lies within the zone of a cancer lethal dose of radiation is markedly devitalized by the complete destruction of the finer blood supply. In such bones as the mandible such an effect is evidenced by a lack of any sanguineous oozing from the cortex or the medulla when the bone is sectioned although the mandibular artery itself may still be patent. After complete destruction of the intimate circulation, the affected bone may remain *in situ* and function normally provided that it is not exposed by necrosis or other solution in the continuity of the overlying soft tissues. If heavily irradiated bone is exposed by any means, osteomyelitis inevitably occurs, and the devitalized bone subsequently acts as a foreign body which must sequestrate and be extruded before healing can occur. It is an error to speak of radio-osteonecrosis of bone as being produced by radiation alone, for even though the bone is completely devitalized it will function just as well as a piece of ivory or metal plate provided that infection is not introduced.

The most frequent cause of osteomyelitis in cancer of the floor of the mouth is the exposure of

the inner surface of the mandible by necrosis of overlying soft tissues. A second cause is the extraction of teeth so as to expose the heavily irradiated bone in the tooth sockets. Once infection has been introduced and osteomyelitis has occurred in an area of heavily irradiated bone, the infection usually spreads through the entire radiated area of bone, all of which must sequesterate before healing can take place. This fact is one of the best arguments for the use of the smallest feasible portals.

When osteomyelitis occurs in the anterior mandibular arch with necrosis in the floor of the mouth, there is usually an extension through the skin of the submental region. The anterior portion of the mandibular arch finally sequestrates, producing a marked deformity. The normal contour of the chin is lost, and the tongue, having lost its anterior support, recedes backward into the pharynx. The perforation through the submental region can be closed by plastic repair, but articulated speech is greatly altered. Despite the cosmetic and functional deformity, these patients may live on quite comfortably in excellent health. The treatment for osteomyelitis should be conservative, and operative removal of bone should be deferred until the severity of the symptoms warrants it or until it is certain that the further progress of the involvement has ceased. In many instances, it is best to defer the removal of the sequestrum as long as possible or until it has become loosened by itself.

Osteomyelitis occurred in about 25 per cent of the present series. It has become much less frequent in recent years since the use of small peroral portals for x-radiation has been made routine. It occurred more frequently (36 per cent) in the cured cases than in the fatal cases (18 per cent), which indicates that it is justifiable in an effort to control an otherwise fatal disease. We do not concur, however, in the opinion of some authors that osteomyelitis of the jaw is inevitable with adequate radiation treatment.

*Dental complications.* As has been previously mentioned, the patient with cancer of the floor of the mouth is fortunate if he is edentulous. Dental complications may serve both as a cause and as a result of osteomyelitis. Cancer lethal doses of radiation cannot be given safely over large areas through the gingival margin. Under such dosage, the teeth are devitalized, the gums recede, and serious dental sepsis occurs. Finally the teeth become painful and loose, and if they are extracted the tooth sockets do not respond as in the normal by filling with granulation tissue, so that they may finally heal over with mucous membrane.

In the typical case, the devitalized bone remains exposed in the tooth socket and diffuse osteomyelitis soon becomes evident.

The incidence of these complications is greatly reduced by using the smallest portal which will adequately cover the primary lesion. Heavy irradiation of the teeth and the gingival margin cannot be entirely avoided, but in these cases subsequent difficulties may be largely prevented by cutting off the teeth rather than extracting them, killing and extracting the nerves, and filling the root canals, leaving the roots in place permanently, if possible. In some instances, dental restorations can be made.

*Adenitis of the submaxillary salivary gland.* In cancer of the floor of the mouth, there is practically always invasion of the submaxillary salivary duct with obstruction to the outflow of saliva and, in some cases, the entry of bacteria into the duct and gland. This complication seldom goes on to frank suppuration within the salivary gland itself, but there may be marked swelling and tenderness in these regions. At times the swelling of the submaxillary salivary gland may closely simulate metastases, and the differential diagnosis is important since there is a lymph node which lies deeply embedded within the submaxillary salivary gland, to which metastasis may occur. Although productive of some pain and discomfort, the infection of the submaxillary salivary gland seldom calls for any special measures of treatment except that the gland should always be removed when a neck dissection is performed.

*Recurrent and residual cancer.* In the present series following treatment by radiation, there was recurrent or residual cancer at the site of the primary lesion in 20 cases, or 19 per cent. Next to metastasis, this complication is one of the most serious in cancer of the floor of the mouth and occurs more often than in cancer of the lip (6 per cent). The frequency with which it occurs may often be due to the surgeon's effort to use the minimal effective dose and to avoid as much as possible the danger of radionecrosis and osteomyelitis. In our series, of the 20 cases of local recurrence, subsequent treatment was successful in 7, or 35 per cent.

#### PROGNOSIS

Cancer of the floor of the mouth has always been considered one of the most malignant of intraoral tumors. From the reports of many writers, one might infer that the disease is practically incurable. The results in our clinic appear to be about the same as in cancer of the tongue. It is probable that the former bad prognosis of



TABLE I.—FACTORS INFLUENCING THE 5 YEAR CURE RATE IN 87 CASES (DETERMINE GROUP) 1930 TO 1934 INCLUSIVE

	Total number of cases	Number of 5 year cures	Per cent of 5 year cures
Age in years			
Below 40			00
40 to 49	0	3	33
50 to 59	34	9	26
60 and over	52	8	6
Not stated			
Position of the growth			
Anterior one third	73	20	27
Middle one third			
Posterior one-third			
Crosses midline	42	6	7
Histopathology:			
Epidermoid carcinoma grade I	5		40
Epidermoid carcinoma grade II	65	6	9
Epidermoid carcinoma grade III	8	3	38
Epidermoid carcinoma ungraded	7		
Adenocarcinoma			50
Metastases			
None on admission	59	8	13
Present on admission	28	4	4
Developed after admission	8	0	33
Metastases sometime	46		
None at any time	4		50

cancer of the floor of the mouth was due mainly to the inadequacy of purely surgical measures to deal with this tumor except in a small percentage of early cases. A statistical analysis of the main factors which influence the prognosis are given in Table I. The most significant of these will be discussed separately.

**Age.** The average age of the patients on admission was considerably older (5 years) than the average of those who survived 5 years after treatment. An analysis of the 5 year survivals by age decades indicates that the prognosis is less favorable with advancing age—16 per cent after the age of 60 as compared to 5 per cent in the whole group. The total number of cases is so small that the latter figure must not be taken as absolutely representative of the facts in this regard. The poorer prognosis in the older age groups is characteristic of those anatomical forms of intraoral cancer in which complications are serious, as for instance cancer of the floor of the mouth or tongue. In cancer of the lip in which aggressive treatment introduces relatively few serious complications, the age of the patient does not markedly influence the prognosis.

**Position of the growth.** The lesions situated anteriorly offer a better prognosis (27 per cent) than those which arise posteriorly (7 per cent). The average diameter of all cases was 3.5 centimeters. The average diameter in the 5 year sur-

TABLE II.—5 YEAR END-RESULTS 1930 TO 1934 INCLUSIVE

Total number of cases	
Indeterminate group	
Dead as result of other causes	1
Lost track of without recurrence	3
Total number of indeterminate results	
Determinate group	
Total number minus those of indeterminate group	
Failures	
Dead as result of cancer	60
Lost track of life disease	5
Total number of failures in treatment	
Successful results	
Five from disease after 5 years or more	
Net 5 year end results	
Successful results divided by determinate group ( / 87)	

This series consists of all histologically proved cases of cancer of the floor of the mouth, both early and advanced, admitted during the specified period. Only those patients are excluded who, for any reason, are unable to return for treatment, palliation and observation in the out patient department, and those who are lost track of while the first month after no more than one or two relapses (fatal shapen).

Survival was about 5 centimeters as compared to about 3 centimeters in the fatal cases. The duration of symptoms in the total group was a little over 6.5 months. In the cured group the average duration was 5 months as compared to about 7.5 months in the fatal cases.

**Histopathology.** In our relatively small group of cases, the histological grade of the tumor apparently did not seriously affect the prognosis. The variations in groups I and II are probably only coincidental.

**Metastases.** As in all forms of cancer the presence or absence of clinically demonstrable metastases on admission is one of the most important factors in the prognosis. When present on admission, the 5 year survival rate was only 14 per cent, and the variations in the survival rate depending upon other classifications in this regard are shown in Table I. In those cases in which metastases did not appear at any time during the course of the disease the cure rate was over 40 per cent.

#### END-RESULTS

In the present series the net 5 year cure rate (calculated on the determinate group) is 25 per cent (Table I). Of the total of 87 cases, 87 can

be classified as determinate. The 16 remaining are considered indeterminate for the following reasons: 13 died of unrelated causes after freedom from disease for at least a year before a 5 year period had elapsed, 3 were lost track of before the end of 5 years without recurrence for at least a year following treatment. Of the 87 determinate cases, 60 died of disease and 5 were lost track of with disease, a total of 65 failures in treatment.

A survey of the literature reveals few reports of 5 year end-results which include sufficient data so that the figures can be accepted without reserve. Regaud, in 1932, reported 77 cases treated by radiation at the Curie Institute with 22 per cent 5 year cures, but he does not give sufficient data to establish whether this figure represents net or gross cures, nor does he account for those lost track of with and without disease. Berven (2, 3) reports that between the years 1906 and 1930, 40 patients were treated at the Radiumhemmet, of whom 14, or 35 per cent, survived 5 years without recurrence, but he does not state whether all cases in all stages of the disease are included in this group, and he does not account for any patients dying of unrelated causes. Golden reports on 46 patients of whom 12 were lost and only 3 were free of disease for one year. Bloodgood, Dorrance, McKillop, and Cutler simply state that the prognosis is unfavorable and make no specific mention of any cures of their own. Ducuing reports 40 patients treated by radiation in which only one survived for at least 3 years. There are, however, several reports of single cases in which the patient survived more than 5 years.

#### SUMMARY

This series consists of 103 unselected consecutive cases of all comers with cancer of the floor of the mouth in all stages of the disease, admitted to Memorial Hospital during the years 1930-1934, inclusive. The etiology, clinical course, method of treatment, end-results, and prognosis are described in detail. The net 5 year cure rate is 25 per cent.

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# A COMPLETE TECHNIQUE OF HEMORRHOIDECTOMY

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**H**EMORRHOIDECTOMY is an ancient operation. Galen ligated the base of the internal hemorrhoid on each side and allowed the mass to slough away. Hippocrates was the first to practice excision. Since the original operations, many ways of curing hemorrhoids have been described. A good many methods are not new but are merely repetitions of surgical procedures already devised.

Our method of hemorrhoidectomy justifies a complete detailed description because it corrects something that has previously been overlooked. We would call attention to a fourth hemorrhoid, which is almost constantly present and the removal of which has resulted in a much higher percentage of permanent cures than that given by any previous technique. Complete details of our method will be given to enable any first class proctologist to try it. Some of the individual features of the operation have been used previously by other proctologists. However a careful scrutiny of the literature fails to reveal any single operation which has taken advantage of as large a number of the refined maneuvers included.

## INJECTION TREATMENT OF HEMORRHOIDS

There are still some unscientific men who use the injection method, and quite often these men have large rectal clinics. We have watched some of these men at work, and have even read one of their textbooks as well as a volume on their clinics. The fact that men with little skill can use the injection method with such ease is in itself a condemnation of it although not an absolute one. Skillful men of the caliber of McPheeters bring the art of injection to its highest point and would never be found guilty of using the method in the presence of infection or of an acutely thrombosed, internal, strangulated prolapsed hemorrhoid. We contend that proper injection can be done by only a relatively few expert proctologists.

Hemorrhoids may be classified in three general groups: (1) those with painless bleeding at defecation—in these anemia is often present; (2) those in which there is spontaneous reduction of prolapse after defecation; and (3) hemorrhoids which prolapse very easily and may occur after any muscular effort such as coughing, dancing, or walking.

Injection is usually recommended only for hemorrhoids of the first degree. Very occasionally it may be used for those of the second degree.

Injection is contra indicated in many instances. In the presence of pain which is an absolute contra indication since it usually means infection, such as fissure ulcer or abscess. In the presence of cryptitis and papillitis. In the presence of extensive prolapse often with strangulated or inflamed piles, in the presence of large external skin tags, which usually mean deeper associated anorectal lesions. In the presence of polyps and in young patients. Bule and Rankin mention, in some instances, an idiosyncrasy to a drug as a real danger to injection.

In our own experience, which is corroborated by that of the Mayo clinic, it is rare to find internal hemorrhoids in the absence of external ones. Similarly it is nearly as rare to find external ones in the absence of internal ones. This is in direct contradiction to some of the literature which in many cases states that there are four to seven times as many internal as external hemorrhoids. Unless acute thromboses are present, the surgeon should remove both types of hemorrhoids at the same time. This makes the reasons for injection in most cases, become more and more difficult to understand.

The Mayo clinic proctologists have found uncomplicated hemorrhoids to be productive of little if any discomfort and in this we agree. Pain is the symptom of a complication usually infection, which demands surgical care. It is then that the patients finally reach us seeking relief and it is time for surgery. Evidently when hemorrhoids are symptomless and there is not much bleeding, patients do not come to the proctologist.

Once gain, we do not deny that the quick, so called "rectal specialist," the injection treatment is a boon. Unscrupulousness sometimes overcomes better judgment especially if the patient can pay and unfortunately in the hands of such men hemorrhoids are always found and the injection treatment instituted. The experience the quacks thus gain, is by the sadder experience of the patients they learn what and where the pectinate line is and not to inject below it or too close to it. These statements of course do not apply to such men as McPheeters. The relatively

few high class proctologists who are experts with the injection technique will agree in general with its shortcomings, including recurrences

Briefly summarized, the principal objections to injection treatment of internal hemorrhoids are (1) the condition is too advanced, (2) the presence of complications, such as thrombosed, prolapsed hemorrhoids, (3) the presence of associated pathological conditions such as infection and external hemorrhoids

#### DIFFICULTIES ENCOUNTERED WITH OTHER SURGICAL METHODS

1 *Clamp and cautery* The clamp and cautery method is one of the most commonly used. It is not the technique of the proctologist but of the general surgeon who does occasional proctological work. We have many objections to it, most of which have been verified by numerous other proctologists. Not one of the least of these is the failure to remove associated pathological lesions in the anorectal area at the time of the operation.

The Mayo clinic group has stated that deformity is often present about the anal margins, due to the piling up of skin and to the existence of large varicosities beneath the surface of the skin. When the clamp and cautery operation is done, frequently little effort is made to dissect out the varicosities beneath the anal margins before the clamp is applied.

Lockhart-Mummery has said that the clamp and cautery operation is not so complete, and that there is a likelihood of recurrence following its use. Frequent complications are stricture and secondary hemorrhage. Mechling has condemned the searing of the mucous membrane of the anorectal area for these same reasons, as well as for the leaving behind of crushed, burned tissue. Hirschmann has said that the use of a hot iron in a mucus lined cavity is too prone to be followed by strictures. As we well know, there is a mucocutaneous covering over the lower part of the anorectal area, whereas the upper portion is covered only by mucous membrane.

Loring has shown that an effective treatment for prolapse of the rectum is removal of the internal hemorrhoids with elliptical strips of mucosa, by the clamp and cautery procedure. This method relies on the formation of scar tissue which holds up the rectum but causes a consequent diminution in the caliber of the rectal lumen. Therefore a case of prolapse must have an accompanying enlargement of the rectum to be suitable for this type of operation.

2 *Ligature operation* The ligature operation has been used by many men, notably Yeomans,

Hirschmann, and Goodsall. The danger of recurrence is admitted. Mechling has condemned ligation of the anal membrane for many reasons, such as pain and hemorrhage. We have tried it and have found that the patients suffered too much postoperative pain. Three of our patients had postoperative hemorrhage, and this has been the experience of others. Associated pathological lesions are not removed.

3 *The Whitehead operation, and its modification, the amputative method* As Yeomans has said, the Whitehead operation has rightly become almost obsolete. A few men hang to it, tenaciously, possibly because of their actual, exceedingly great skill in surgical technique, and a certain, justifiable degree of pride in exhibiting it.

Mechling has stated that it is never necessary to do an amputative type of hemorrhoidectomy, since healing is never primary and is followed by granulations producing stricture, and prolapse of the mucous membrane constituting the aptly termed "Whitehead deformity." Hirschmann has adequately shown how incontinence with eversion and cutaneous overgrowth has occurred.

We do not use the operation. We can speak only from the experience gained by the sad cases, which have come to us, with functional and anatomical deformities following its use.

4 *Condemning oversewing and burying of stumps of mucocutaneous tissue under oversewed mucosa* The burying of crushed mucocutaneous tips or teats of tissue under an oversewed mucosal surface is a violation of good surgical principles, especially when this is done in an infected area. The anorectal region is constantly being flooded with infected material, i.e. feces. This crushed cutaneous tip often undergoes sloughing, and we have tried the method a few times to verify this fact. Any infection buried beneath the oversewed mucosa can become more virulent with ease. Abscesses and strictures take place too frequently.

The Mayo clinic makes use of this maneuver to a certain extent. However, the extreme skill of their operators and the careful after-care of their patients causes a low number of complications. This also applies in the case of Lockhart-Mummery, who uses oversewing of the mucosa.

Location of any postoperative hemorrhage is much more difficult in the presence of oversewed surfaces. This is as true here as in the case of a postoperative hemorrhage within a closed abdomen.

5 *Miscellaneous a Cutting circularly around the anal orifice* This is against one of the funda-

mental rules of surgery as it tends to produce a stricture. In the past, Yeomans and Lockhart Mummery have used modifications of this technique. If the surgery of the stomach and the intestine is recalled the fallacy of this procedure is readily perceived.

**b Use of local anesthetic**—except on thrombotic external hemorrhoids demanding immediate care. This procedure tends to distort the tissues. Accurate removal of the proper amount of tissue is difficult for us to judge. The Mayo clinic is to be commended for their development and extensive use of caudal and caudal-sacral block anesthesia in the field of anorectal surgery.

**c. Immediate removal of internal hemorrhoids in the presence of edema of the rectum infection and acute thromboses of internal hemorrhoids.** The Mayo clinic group has shown that it is difficult to judge the amount of tissue to remove if there is much edema. This is observed when thrombotic, internal, protruding piles are replaced. If infection is present, there is the same difficulty plus the dangers of cellulitis.

We believe, as does the Mayo clinic group Lockhart Mummery and Yeomans that when sloughing gangrenous, internal hemorrhoids are present, it is usually best to operate immediately. Of course we grant that this is a moot point and should be judged according to the merits of the individual case.

**d. Attempt to make an office procedure of a hospital procedure.** The advantages of this method are (1) It is usually easier to get a patient to submit to surgery in the office and (2) the proctologist more frequently collects for his services, since the patient does not have to pay a hospital bill.

Hirschmann, one of the greatest living proctologists, makes an office procedure of what we regard as a major proctological operation. He dispenses with one assistant, four forceps and a weight, giving the exposure of the operative field. The method of exposure in surgery is always important. Proper removal of associated pathological lesions may be missed by Hirschmann's method, due to the distortion of the operative field, certain portions of it being under too great tension. The dangers and difficulties attending hemorrhage with patient away from the office or hospital are only too apparent. After-care during the first 4 or 5 days is made difficult for the patient and the physician. Hirschmann's method can be mastered by only a few experts. It is not safe in the hands of the majority of proctological surgeons. Hirschmann's easy and sure manner of performing the operation must not unduly sway

others to try it. Hirschmann is in a class by himself.

#### OUR SURGICAL METHOD

Our method can be used by any competent proctologist. We have attempted to overcome such objections as we have noted in other techniques. In addition we wanted to develop a method that would (1) avoid postoperative infection (2) give absolute control of bleeding, thus insuring no postoperative hemorrhage and (3) give good final results, with a short, comparatively painless, postoperative course.

Many of the general features of this technique can be applied to other operations about the anus and rectum. However since hemorrhoidectomy is the most common operation in proctology this is presented specifically.

**Pre-operative care.** The usual pre-operative diagnostic work routine is carried out. It consists of digital, anoscopic and sigmoidoscopic examinations in all cases, and x ray and stool examinations as indicated.

The day preceding the operation the patient is kept on a regular diet. About 8:00 p.m. an enema of quart of physiological saline solution is given, with No. 24 French soft rubber catheter with a velvet eye tip. A hard rubber tip or a colon tube is not used, since this causes trauma at the anal margin. Three grains of sodium amylal are given by mouth at 8:30 p.m.

On the following morning, if the operation is to take place at 8:00 a.m. an enema is given at 6:30 a.m. Six grains of sodium amylal are given by mouth at 8:00 a.m., and 3 grains at 7:00 a.m. One-sixth grain of morphine and 1/50 grain of atropine are given hypodermically at 7:30 a.m. This sedation usually assures a relaxed, unanxious patient. Water is forbidden the patient after 5:00 a.m. At 7:30 a.m. the patient voids and then is brought to surgery.

**Anesthesia.** The anesthesia of choice is caudal and paravertebral block given in the usual manner. Twenty-five to 35 cubic centimeters of one per cent metyraline (formerly novocain) is injected into the sacral canal. Ten cubic centimeters of one half of one per cent metyraline is injected into each of the second paravertebral foramina.

General anesthesia of cyclopropane is used rarely under 2 conditions (1) if the patient refuses caudal paravertebral anesthesia (2) in the unusual event that caudal-paravertebral anesthesia fails. This failure is usually due to a misplaced caudal needle. Occasionally it is caused by an attempt to operate upon the patient too

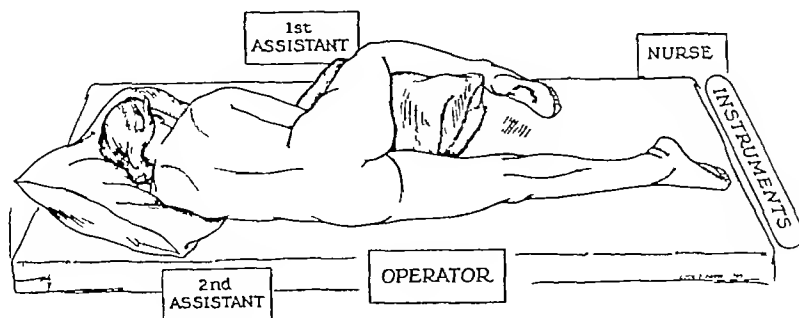


Fig 1

soon after the anesthetic is given. Sometimes when cyclopropane is given, peri-anal infiltration has been used. One half of one per cent novocain with adrenalin has been the solution injected. Muscular relaxation is aided by the novocain, and the adrenalin tends to prevent some of the excessive oozing which occurs with the cyclopropane. However, the distortion of the tissue caused by the use of a local anesthetic offsets, to our minds, a good deal of the advantages it offers.

The usual rectal operation is emphatically not enough of a major procedure to justify the use of spinal anesthesia. These patients frequently must be up to void within 10 to 12 hours after operation. When a spinal tap has been made, if the patient must arise it will cause disagreeable headaches in a large percentage of the cases.

**Position.** The position of the patient may be seen in Figure 1. He lies on his left side with the left lower extremity held out in an unbent position, and with a pillow under the flexed right leg. The body falls toward the left side. This exaggerated Sims position gives a good operative exposure without the sacrifice of any convenience of position for the surgeon. It allows the assistants to be of active service, which is difficult when the patient is in a lithotomy position. Over-engorgement of the hemorrhoidal area, with the resulting removal of too much tissue is not apt to occur in this posture.

At this time, while the anesthesia is becoming effective, the peri-anal region is shaved. Partial relaxation and anesthesia is present, which makes the procedure less difficult and painful.

**Preparation.** The perineum and anus are painted with tincture of mercuric iodine and drapes are placed. The effectiveness of the caudal-paravertebral anesthesia is now tested. A No. 22 needle, 2.5 inches in length, is pushed subcutaneously, the lines of its insertion forming a parallelogram about 1.5 inches from the border of the anus. If the anesthesia is not complete, one half

of one per cent solution of metycaine is injected subcutaneously. While the injection is rarely required, the test with the needle is used in all cases to avoid hurting the patient during the operation. For reasons stated we do not like to use local anesthesia. Tincture of mercuric iodine is then applied to the anus and rectum.

A folded gauze sponge, with a long, attached string, is pushed high up into the rectum, about 3 to 5 inches above the pectinate line (Fig. 2A). This is an important step, as the sponge serves a number of functions: it acts as a block against stool coming down into the operative field, it prevents blood from going upward into the bowel, and by its later return obscuring the operative field or causing the surgeon to search for a source of hemorrhage.

**Operation.** While the number of hemorrhoids and their position varies, in general there are three main hemorrhoidal masses and one small or minor hemorrhoidal mass. One hemorrhoid is constant in position, it is always located in the right anterior quadrant. The two other masses are located on either side of, and in front of, the posterior commissure, one in the right posterior and one in the left lateral area. The smaller or minor hemorrhoidal mass is usually in the midline, posteriorly. It should always be removed if present, however small it may be. The frequent recurrence of hemorrhoids after an otherwise complete hemorrhoid operation, is usually due to the failure to remove this relatively small mass.

The order of removal of the hemorrhoids does not have to be set, but the following sequence usually is observed (Fig. 2B): first, the left lateral, second, the right anterior, third, the right posterior, and fourth and last, the small hemorrhoidal mass in the midline, posteriorly. The frequent difficulties encountered due to the oozing of blood from the site of a freshly removed hemorrhoid, flowing down and obscuring the field of operation, will be minimized by this sequence.

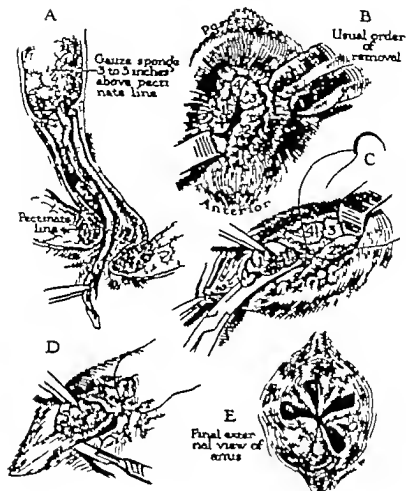


Fig.

Exposure of the hemorrhoids is as important as exposure elsewhere in the domain of surgery. This is illustrated in Figure 2C. The skin about 3 inches from the anorectal line is grasped with a 5 inch curved Kelly forceps. This forceps is placed in the proper position to make traction on the skin in line with the internal hemorrhoid. The internal hemorrhoid and the external hemorrhoid or skin tag, then present themselves as an anatomically unified defect, and both are removed as one piece of tissue. With this exposure it is easy to take care of all other pathological tissues near the hemorrhoidal mass. A modified Sims retractor (a flat, rigid, right angled retractor) is placed in the rectum opposite the hemorrhoid. By pulling on the retractor and the forceps in oppo-

site directions, wide exposure without trauma is obtained. Forcible dilatation of the rectum is never done. Sometimes, with chronic fissures, the anal contracture is sufficient that an anal speculum or the finger is not easily admitted. In these cases, incision is made in the midline posteriorly cutting down through the sphincter muscle. Painful hematoma and muscle destruction caused by forcible divulsion, frequently resulting in incontinence are thus avoided.

Lighting is obtained by two means the first, the standard overhead, surgical lamp second a portable surgical lamp placed so as to have the rays directed into the anal canal.

If the hemorrhoids are of the usual small or moderate size a 5 inch curved, Kelly forceps is

placed on the hemorrhoid, as illustrated in Figure 2C. The forceps grasp the mucosa, the top reaching toward the upper pole of the hemorrhoidal mass and extending upward  $\frac{1}{2}$  to  $\frac{3}{4}$  inch superior to the pectinate line. The lesser curvature of the forceps faces downward. About one-sixteenth of one inch above the tip of the forceps, a quarter length suture ligature of No. 00 chromic catgut threaded on a small, round, full curved needle is passed down through the mucosa just to the muscle, thus picking up and encircling all of the blood vessels. If it is passed too superficially, submucous bleeding occurs, which is very troublesome. If it is passed too deeply, it will include a part of the sphincter muscle, obviously interfering with its function. The suture ligature is tied in the middle. The hemostat is now taken off the hemorrhoid and clamped on the two ends of the suture ligature, which now further acts as a guide for the removal of tissue.

If the hemorrhoid is large, a Tuttle battle-axe forceps is placed slightly above the anorectal line, lifting the upper portion of the redundant tissue in its jaws. The Tuttle forceps serves the same purpose, in a general, limited way, as did the small hemostat. It lifts the hemorrhoidal mass from the musculature of the rectal wall.

The next step is the removal. With a dissecting type blade in a Bard-Parker knife, an incision is made along the lateral surface of the hemorrhoid. The incision starts just below the suture ligature, its shape being seen best in Figure 2D. External hemorrhoids or skin tags, infected crypts, and infected or hypertrophied papillae are nearly always present. Therefore the incision should extend onto the skin 1.5 to 2 inches below the pectinate line in order to give proper drainage. When the cut is being made, the hemorrhoid is gently held away from the knife by means of a toothed-thumb forceps, held in the left hand of the operator. At the same time the first assistant exerts countertraction in the opposite direction, by means of a similar pair of thumb forceps pulling gently on the rectal mucosa. A second incision is made on the other side of the hemorrhoid, and is of the same order as the first incision except that the ellipse of the curve is reversed. The second incision meets the first one at both extremities to form a parallelogram with two V shaped ends. Incisions on the two sides of the protruding mass should tend to meet underneath it. When the hemorrhoidal tissue is clipped away from the remaining mucosa, there should be a falling together of the edges of the mucosa.

The apex of the "V" on the skin is picked up with the thumb forceps. Dissection is made un-

derneath the hemorrhoid with sharp-pointed scissors, curved, and held on the flat, or with a knife. Dissection extends down to the fascia covering the subcutaneous sphincter and the superficial portion of the external sphincter, but must not ever include the muscles. It must avoid being too superficial, however, or it will fail to include all of the hemorrhoidal vessels. The dissection is continued up to within about  $\frac{1}{8}$  inch of the transfixion ligature, and then the hemorrhoid is cut off distal to the ligature.

A hemostat is placed across the remaining tissue distal to the ligature, and a second suture ligature is placed beneath this stump. The bleeders now seen are caught with small, curved, Kelly hemostats and ties of No. 00 plain catgut are used. Great care must be taken not to include mucosa or skin in picking up these submucosal bleeders, since this would defeat one of the great advantages of this technique. The transfixion ligatures are the only ones which include mucosa, and their long ends are now cut fairly short. This completes the removal of one hemorrhoidal mass. The other masses are removed in the same manner.

The final steps in the operation include the following. When the bleeding is controlled thoroughly, the sponge with its attached string is pulled out. If additional sponges had to be pushed up above the operative area to block seepage of liquid stool, these are delivered when the main gauze sponge is removed. All blood is kept from finding its way into the upper portions of the rectum and rectosigmoid. If a sponge should be left it will pass with the stool. However, since it usually acts as a block to an easy passage, this should be avoided.

A Hill type speculum is then inserted into the anal canal and the freshly operated upon areas are inspected. All blood is cleaned from the anorectal area in order that a clean view of the field may be obtained and, since all apparent bleeding is controlled, if any postoperative bleeding occurs the operator will know that a fresh hemorrhage has taken place. This point has been stressed by the Mayo clinic group.

With the speculum left inserted, it is made certain that all visible pathological lesions of the rectum have received proper care. A sponge saturated with 2 per cent tincture of merthiolate is placed in the anal canal, and the speculum is withdrawn. The sponge is removed after 1 minute has elapsed. The speculum is replaced and any excess of tincture of merthiolate remaining in the rectum is taken up with a dry sponge.

One ounce of eucupin ointment is injected into the anorectal canal by means of a glass syringe



with a catheter tip. A firm, gauze pressure dressing is laid over the anus and held in place by means of two strips of adhesive. The dressing is pulled tightly against the perineum. Anesthetic ointments do not prevent postoperative pain to any appreciable extent. Gentleness in handling the tissues and adequate care of all visible anorectal lesions have been found to be more effective.

The following precautions may be noted. Tincture of mercuric iodine is used freely throughout the operation. Each hemorrhoidal area is painted before excision, and the exposed area remaining after removal of the hemorrhoid is swabbed with the antiseptic.

Caution is always used to leave strips of mucosa between the areas of excision. If this is not done, the difficulties encountered with the Whitehead operation are prone to appear.

Prolapsing, thrombotic, internal hemorrhoids are replaced. They are held in position by means of an external, plug pressure dressing. No operative work is attempted while they and the surrounding tissues are in an edematous and distorted condition.

Thrombotic, external hemorrhoids receive the accepted, usual care. An elliptical incision with a scissors is made. Shelling out of the clot is done after which care is used to look for any bleeding. No other surgery is done at the time.

The associated, visible pathological tissues receive thorough care. Infected crypts must be excised. Enlarged, frequently infected papillae are usually removed, along with the hemorrhoidal masses. These are two of the most commonly found associated pathological conditions.

Fissures and ulcers have been discovered in about 3 per cent of the patients presenting themselves for hemorrhoidectomy. They are generally situated in the midline posteriorly. Chronic fissures and ulcers should be excised with care to include the indurated, infected tissue surrounding them. A few of the muscle fibers of the external sphincter should be divided. This midline wound must be kept open so that it will heal in from the bottom. This is aided by placing a strip of lined gauze tape one-half inch wide, one and one-half inches long and of one thickness, flat in the wound. This will remain in place for about 3 days and will not interfere with bowel movements. This packing is placed to the anal exposure of the field with a small Sims speculum. Occasionally an early fissure is seen. With these, we merely cut down through the fissure and a few of the muscle fibers of the external sphincter.

If any small fistulas are present, these receive care after other operative procedures are com-

pleted. If they are large and extend onto the perineum, the operation is performed with the patient in the lithotomy position. While this position is the best for large fistulas and anterior fistulas, nevertheless it is not so good for the excision of hemorrhoids, due to the engorgement of the field.

#### ADVANTAGES OF THIS TECHNIQUE

1. Postoperative recurrences requiring second any operation are a rarity. We feel that the removal of the fourth small midline posterior hemorrhoid along with the associated pathological process which is frequently present in this area, contributes greatly to this success. This is the first time this fact has been called to the attention of surgical proctologists.

2. Postoperative infection is rare following the use of this technique. All traumatized tissue is removed. No undermined or pocketed mucosa or skin is left behind. There is no sewing or tying together of edges of undermined mucosa or skin, and no traumatized mucocutaneous tears are sewed or tied to mucosa. The avoidance of over sewing makes more feasible the removal of associated anorectal disease, since ample drainage is present. The large incision into the skin and the shape of the incision aid the drainage. No irritating rectal plug or larger anal packs are used.

3. Hemorrhages do not occur with this method. The suture ligatures insure unusually good control of bleeding.

4. A short, comparatively painless, postoperative course follows this operation. Modern, postoperative treatment has decreased the pain after almost any type of hemorrhoidectomy. The regimen in general avoids the constipating measures, uses a quite liberal diet, and have the patient semi-ambulatory at an early date. This method is unusually painless due to the care taken not to tie the skin edges together.

5. Good final results are obtained. A good postoperative result implies that the patient must have good control, that all visible pathological lesions of the anorectal area have been removed, that the anal outlet must be of normal caliber and if possible that a good cosmetic result has been obtained.

This operation gives these desired good final results for a number of reasons.

The sphincter muscle is not damaged. It is not traumatized by forceful dilatation. Stretching causes hemorrhage and infection with resultant scarring and weakening. There is no danger of cutting the sphincter muscle since the hemor-

rhoid is lifted away from it, thus making separating dissection an easy matter. In the case of the small hemorrhoid this is accomplished by the use of the crushing clamps, and in the case of the large hemorrhoid by the application of the battle-axe forceps.

2 Unusually adequate exposure is afforded by the combination of a good anesthetic and the use of a retractor and a Kelly forceps to make traction in opposite directions.

3 Associated pathological lesions are easily corrected. The operative field is divided into units, and the work is thoroughly completed in a given unit before that in another is started.

4 The fourth hemorrhoid is removed.

5 No circular incisions around the anal canal are made. Such incisions tend to cause strictures.

#### TREATMENT AFTER THE OPERATION

Upon return from the operating room, the patient is given  $\frac{1}{2}$  grain of codeine and 10 grains of aspirin, by mouth. This is repeated every 4 hours, as needed. An order is left for  $\frac{1}{4}$  grain of morphine by hypodermic injection if necessary, but less than 5 per cent of the patients require any morphine after operation. The patient lies on the ventral surface of the body for 1 hour after operation, to cut down venous stasis and bleeding in the operative area. He may then assume any position that he wishes. If necessary, he is allowed to get up to void within 10 to 12 hours following the operation. Catheterization should not be done too soon on these patients. If catheterization is once started it is difficult to stop. Most of these patients will void if given a little time, and the Mayo clinic group advocate the avoidance of catheterization for at least 18 hours after operation. Loosening of the pressure bandage is often valuable in aiding the patient to void during the first 24 hours.

On the first day after operation, that is the day after the operative day, the patient is allowed up and about. On sitting up, the patient had best use a hard chair, as this will be found more comfortable than a cushion which would push up on the operative area. If the patient wishes to sit in a reclining chair, two small pillows may be placed side by side with a four inch space between them, or a rubber ring may be used. A liquid diet is given for lunch and a soft diet for supper the day of the operation, and an all cooked, full bland diet is given starting with the first day after operation.

Difficulty in voiding after the first 24 hours may be relieved by urging the patient to urinate

just before leaving the hot sitz bath. Hot sitz baths are given twice daily, and after each defecation, starting on the first day after operation. The utmost precaution should be observed in giving hot sitz baths. An attendant should remain constantly with the patient, because these people, if left alone, frequently get out of the tub quickly and occasionally faint. The sitz baths must be as hot as the patient can bear, and must be continued 15 to 30 minutes to be of any value.

On the first day after operation 1 ounce of petrolagar containing phenolphthalein is given every 4 hours. Starting on the second day after operation 1 ounce of plain petrolagar is given every 4 hours. With these measures the bowel will usually move on the second day after operation and occasionally on the first. Unusually a patient is seen, often of a neurotic type, who will hold back with his stools due to the fear of pain. In these cases an olive oil retention enema and  $\frac{1}{4}$  grain of morphine by hypodermic injection are given. One hour after the oil enema an enema of 1 pint of tap water is given. This olive oil retention enema is not given unless there has been no stool by 4 00 p.m. on the third day after operation. Rarely castor oil will be required. This is undesirable because it produces tenesmus and so completely empties the bowel that there will be no stool again for 48 hours. After the bowel movements have been started, the dose of petrolagar is adjusted to the patient's needs.

It is the personal duty of the surgeon to dress the wound daily. Eucupin ointment on an applicator is applied into the anus and rectum to separate the healing surfaces and to prevent adhesions from forming. The ointment is applied daily after the hot sitz baths, which begin on the first day after operation. Irrigations are painful and have been found unnecessary. If an anal pack was used it is removed in 24 hours unless there was a fissure. A binder is applied. Eucupin provides a non-irritating substance, which helps to keep tissues from adhering to each other. It is not used with the thought of controlling any great amount of pain. If an associated abscess, deep fissure, or fistula was present, beginning on the third day after operation it is painted daily with a cotton tipped applicator which has been dipped into tincture of merthiolate. While this is the most painful part of the entire care it is necessary to help prevent infection in those instances in which the wound is contaminated with pus. Most patients can be dismissed from the hospital on the third or fourth day after operation.

When the patient leaves the hospital, the care can be given by the home physician. The patient

comes to the office each day until the end of the first week after operation, every other day during the second week, twice during the third week, and once during the fourth week. When the patient is having stools comfortably the well lubricated gloved finger is inserted up the anorectal canal to discover whether any adhesions are present and whether the anus is of sufficient size. If there is a tendency toward contracture the anus should be gently massaged once every few days until corrected. If this is carried out early contractures do not take place. If a patient is allowed to go without dilatation for several weeks, however contracture with a small anal aperture may occur which will require a second operative procedure to correct. Following the insertion of the gloved finger or the anorectal dilatation, the rectum and anus are painted with tincture of mercuric iodine. The sitz baths are continued once daily for 3 weeks. The patient is kept on a cooked bland diet and plain petrolatum for as long a period as seems necessary this varying from 3 weeks to 3 months.

A final proctoscopic check-up is made by the surgeon 2 or 3 months after operation.

#### SUMMARY AND CONCLUSIONS

1. A new technique for hemorrhoidectomy is presented in detail. The removal of the fourth small midline posterior hemorrhoid as well as the associated pathology so common in the area is described for the first time in the literature. We feel that removal of the fourth hemorrhoid is one of the most important reasons for the superiority of this technique and for the rarity of secondary operations in our series of cases.

2. The technique described minimizes post-operative infection. It thoroughly controls bleeding, the postoperative period is short and comparatively painless and most important the final results have been good.

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body is well recognized and may represent only the terminal phase of its life cycle. *Trichomonas genitalis bovis* (from uterus of cow) were injected subcutaneously into the thighs of 10 women, 6 of whom developed *Trichomonas vaginitis*. Oral administration of the bovis type for 3 days resulted in acute trichomoniasis with positive blood and stool cultures and typical *Trichomonas vaginalis* after 10 days.

Simitch of Yugoslavia established identical human and animal strains in his researches on school children, dogs, and cats. Live *Trichomonas hominis* have been found in milk and in the excreta of flies.

In recent years, more isolated case reports and small series of *Trichomonas* cases in males are being recorded in the literature. At this time reports of about 80 cases have been published. The flagellate apparently occurs much less frequently in males than in females. Stuhler at the Mayo Clinic noted that the incidence was fifteen hundred times greater in females. In males, because of the paucity of available clinical material, urological observations have been limited. The reported incidence of *Trichomonas prostatico-vesiculitis* is exceedingly low (Riba 0.03 per cent Mayo Clinic, 0.5 per cent).

While trichomonads and gonorrhea have been found and reported simultaneously in females, to our knowledge similar findings in the male have not been previously published. Neither has the apparent relationship between damaged or strictured urethra and *Trichomonas* in the male been suggested.

It was of interest to note that in 23 cases of male *Trichomonas* in our office files, a urethral stricture was present in 14, or 6 per cent. After carefully checking our urethral stricture files, we were surprised to find that *Trichomonas* had been identified in 10 per cent—14 in 40—of the cases.

The purpose of this paper is to place on record 20 cases of male urethral strictures in whose genital-urinary secretions trichomonads were found. In cases typical intracellular diplococci and trichomonads were repeatedly noted. Summarizing the 20 cases in this study: 4 were private and 6 were from the clinic. Fourteen, or 70 per cent, were married; 4 were single; a widower and of 1 the status was unknown. Of the 14 who were married, 8 or 57 per cent, of the wives were known to be infected with *Trichomonas*. Thirteen cases, or 65 per cent, admitted previous venereal infection, 5 or 5 per cent, denied previous specific urethritis and in 10 or 50 per cent, the information was not obtained. Five, or 5 per cent, gave a history of previous urethral stricture with

treatment. The Wassermann tests were negative in all cases. The Kahn was positive in one.

Of the 20 cases, 16 or 80 per cent, presented a mucoid or purulent urethral discharge. Stained smears of the urethral secretions showed non-specific bacteria in 9, intracellular diplococci in 2, and only pus cells in 5. *Trichomonas* were found in fresh prostatic secretion in 17 in the urinary sediment in 16 and in the fresh urethral discharge in 11. Pus and shreds in the urine were identified in 18. Pus cells in the seminal fluid were noted in 10 grade 1; 9 grade 2; 6 grade 3; 5 grade 4; 1. On culture 9 cases revealed streptococci in 3 diphtheroids in 2. Gram positive bacilli in 5. Gram negative bacilli in 2.

The treatment in 18 patients included local and general measures. Oral enteric coated acriflavine tablets of  $\frac{1}{4}$  grain were given in 10, sulfanilamide in 3. Local measures included prostatic massages and instillations in 15, urethral dilatations in 16, preliminary electro-urethrotomy in 3, cystoscopy in 7, intraprostatic mercurochrome injection in 1, weak electrocoagulation of posterior urethra in 1, antibiotic treatment in 1.

Follow-up observations revealed that 15 patients, or 83 per cent, became asymptomatic. In 4 or 22 per cent, however, *Trichomonas* were still present. Two patients did not return and in 1 symptoms and infection persisted due to a hemi pyelonephritis.

#### SUMMARY

The association and rather high incidence—20 per cent—of male urethral strictures and *Trichomonas vaginalis* have not been previously described. Two cases are reported in which in addition to the strictures and trichomonads, intracellular diplococci were found. A damaged or chronically inflamed urethra with lowered resistance seems to favor *Trichomonas* adaptation and local morbidity and to provide a source for their dissemination.

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secure integrity of the frame, thus providing for nutrition and reproduction of the involved differentiated cells, constitutes a new problem, experimentation to solve this problem offers a great field for investigators. Just as it is true that function makes the organ, so also is it true that the organ determines the function, that is, morphology regulates function. In the hive, bees put workers' eggs in the small cells, and drones' eggs in the large cells, for the reason that the bee adapts its function to the shape of the cells of differentiated organs. The capillary network of an organ maintains the form of the whole. All the organs are built on the same basic plan and variations in size and arrangement are conditioned by the requirements of function. Every parenchymatous unit is built around a capillary vessel, the vessel is surrounded by mesenchymal embryonal tissue, the morphology of which changes with the function. The architecture of the frame may change but the structural unit always keeps the original characteristics. The frame determines the process of regeneration, as was pointed out by Nageotte in relation to regeneration of bone. The field of bone pathology is very rich in facts supporting this view. Moreover, Beck and Rienhoff's work (1935) on the development of anastomoses between the myocardium and the extracardiac circulation justifies extension of this principle to include the muscular system. Preservation of the original organ-shape has the same importance as the physiological gradient in the development of function.

The great omentum is the largest mesenchymal store in the bodily economy and it plays a very important rôle in compensatory phenomena of adaptation and in regeneration of abdominal viscera. Many highly useful procedures that have been incorporated in

routine surgical practice have been inspired by imitation of nature. The so called omental grafts have their physiological background in the collateral circulation that is developed through adhesions between parietal and visceral serous membranes. The widespread subserous venous capillary network relating portal and caval systems, which respectively are in every artificial or pathological adhesion between the membrane named Providential compensatory and protecting mechanisms are endless in the human body, rational surgical procedures must be patterned after them. The extension to other systems, of Beck and Rienhoff's statements relative to the muscular system, offers and promises new horizons in surgery.

Since 1932, in the University of the Republic, at Montevideo, Uruguay, some contributions have been made to the subject under consideration. The round and falciform ligaments of the liver have been separated from the abdominal wall and have been employed as reinforcing tissues in closure of fifty gastroduodenal perforations. Results were better than when omental patches were used. In one instance, eighteen days after the perforation, the opportunity arose to examine histologically the process of healing and the place of the perforation could be detected only in the mucosa. A well developed collateral circulation had brought about complete regeneration of the submucosal layer.

The fibrous, adventitious sac of a hydatid cyst of the lung remains for years as an empty cavity without showing a tendency to healing, because the circulation to the fibrous, pericystic tissue which has undergone condensation is impaired, congested, and blocked, this tissue is very prone to become infected. Pleural adhesion is insufficient to bring about revascularization of the adventitious sac. In

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## REVASCULARIZATION IN SURGERY

THE surgical production of collateral circulation for impaired organs is a subject of current interest which has been extensively studied. Parenchymatous regeneration and organ grafts which were hailed with so much enthusiasm by surgeons earlier in this century have failed in practice. To graft organs is very difficult and even if the grafts appear to be successful, the physiological effects are not always constant. Physiological autoregeneration however is an established fact. This process is the natural compensatory mechanism of the secretory glands but the regeneration is not always sufficient to maintain adequate function.

Success in transplantation of an organ of which the blood and nerve supplies are cut off is contingent on nutritive juices being delivered by diffusion to the transplanted homologous or heterologous organ. Success perhaps is more likely when tissue of which the blood supply

is normally poor is transplanted. Such tissues are bone, stratified epithelium, or undifferentiated tissue such as embryonal mesenchymal layers. The reason for success in transplanting these tissues is partially due to the physical endurance of the cells and also the potential activity of the tissue.

When the tissue to be used as a graft is highly differentiated, as is the tissue of the glands of internal secretion, nutrition by diffusion is inadequate and the transplant disintegrates and dies. The toxic effect on the graft, exerted by the humors of the host must be considered principally in relation to heterotransplantation. Homotransplantation offers conditions as nearly ideal as can be found in grafting of tissue. Conditions attending the use of familial grafts are intermediary between the other two.

Diminished or abolished activity of parenchymatous organs often is related to impairment of some kind affecting their nutrition. The lesion may be primary in the peripheral capillary network or secondary to impairment of the parenchymatous cells. In both cases the lesion ends in formation of scar by the growth of granulation tissue, which occludes the blood supply, hinders the venous circulation, disturbs reproduction, and ends in atrophy of parenchymatous cells and senility of the organ.

Function may be suppressed by overgrowth of the connective tissue framework of an organ. The unit of the economy of the organ is a colony of cells living within a mesenchymatous frame. The natural or pathological evolution of the organ is, respectively, senility or disease and either of these kills the indefinite power of reproduction of the host. To

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

WITHIN the brief space of 15 months Wallace Mason Yater<sup>1</sup> has revised *Fundamentals of Internal Medicine*. The objectives of the original volume—the presentation of the minimum amount of knowledge a medical student or general practitioner should have at all times—are unchanged. The design, section divisions, and contributors of this volume are identical with those of the original edition.

It is obvious that the stimulus for this revision has come from teaching new classes of medical students. It is apparently Yater's purpose that oncoming classes of medical students should have available in a textbook form the latest important knowledge on all medical subjects. The practicality of pursuing this premise is evident. Such a venture would be a year book of internal medicine. Further it may minimize some of the most valuable adjuncts of good medical teaching methods.

Numerous alterations and additions have been made without increasing materially the size of the text. Extensive illustrations have been reduced in size allowing additional text material. Here and there throughout the volume are inserted extensive revisions (serum therapy and chemotherapy of pneumonia). This revision of a distinctly unconventional method of approach in medical pedagogy has much to recommend it. Medical students have and will continue to find it a real help in their initiation into clinical medicine.

FRED FITZ

likely with increasing age of the mother, hence later children are more frequently afflicted than earlier ones. It is believed that gross congenital malformations in man arise solely from influences that affect the germ cells prior to fertilization, rather than to environmental influences exerted afterward. In the opinion of the reviewer this latter conclusion is not justified on the basis of the evidence presented. Although germinal inferiority is unquestionably a potent factor, properly timed arrests, due to various environmental causes, is probably also important. If the author is aware of the full argument on this topic, his discussion does not indicate such. Indeed, some of his own data can be brought into line with the theory of arrest. Certain other conclusions have not been subjected to sufficiently severe criticism, for example, that the advanced age of the father is a predisposing factor to malformed offspring rests upon one citation related by a colleague.

To the practitioner the most important advice to be drawn is that the parents of a congenitally malformed child can be warned that their chance of having another malformed child is much greater than with other couples, and that the chance of having another defective child will probably be somewhat further increased if the mother is in her third decade, or more, of life.

L. B. AREY

THE *Compendium of Regional Diagnosis in Lesions of the Brain and Spinal Cord* by Robert Bing<sup>2</sup> has been in print for the past 30 years and has undergone many changes in its 11 editions. The translation of this book into English will make it extremely popular.

It is written clearly and concisely, and its 275 pages are chock-full of practical points of cerebrospinal localization. There are two parts, that of localization of spinal cord lesions and that of localization of cerebral lesions. In the first part there is a discussion of spinal cord lesions both in the transverse and longitudinal planes. In part 2 lesions in the brain stem, cerebellum, cerebrum, basal ganglia, and hypophysis are discussed. There are 125 excellent illustrations. Many of these are colored. This book is highly recommended to all neurologists and neurological surgeons. It may be of use to medical students as a reference manual.

THEODORE T. STONE

<sup>1</sup>THE LUNDANE TALKS OF INTERNAL MEDICINE. By Wallace Mason Yater. A.B. M.D. M.S. (in Med.) F.A.C.P. 1st revised. New York: Little, Brown, Appleton-Century Co., 1910.  
<sup>2</sup>CONGENITAL MALFORMATIONS: A STUDY OF PARENTAL CHARACTERISTICS WITH SPECIAL REFERENCE TO THE REPRODUCTIVE PROCESS. By Douglas P. Murphy. M.D. F.A.C.S. Philadelphia: University of Pennsylvania Press, 1912.

<sup>3</sup>COMPENDIUM OF REGIONAL DIAGNOSIS IN LESIONS OF THE BRAIN AND SPINAL CORD: A CONCISE INTRODUCTION TO THE PRINCIPLES OF LOCALIZATION OF DISEASES AND INJURIES OF THE NERVOUS SYSTEM. By Robert Bing. Translated and edited by Webb Haysmiller. 11th ed. St. Louis: The C. V. Mosby Co., 1940.



operation for the condition it is the routine in the university to draw up the fibrous, adventitious sac through the incision in the thoracic wall, and then to stitch the sac to the parietal thoracic muscles. Drainage of the cavity is maintained and is continued for several days. Histological investigation has proved that muscular capillaries ramify on the fibrous wall of the cavity. This process has a remarkable effect, both in aiding spontaneous closure of the fistula and in furthering healing of the cavity.

Alexander successfully closed bronchial fistulas and cavities which had been the site of suppuration by inserting a piece of muscle. In surgery of hydatid cysts, opportunities often are offered to judge the value of this practice.

These are the views and contributions of the University of the Republic, in Uruguay to this new surgical conception. Investigation and clinical observation should enlarge the opportunity for its application especially in the field of endocrinology.

VELARDE PEREZ FONTANA



fresh and decidedly individual approach to many of these disturbing problems. By being acquainted with the author's viewpoint as expressed in this first chapter the reader will derive more benefit from the succeeding chapters than if he uses the book as simple reference on a given subject. This large book covers the field entirely and with its easy style and abundant illustrations it will be deservedly popular.

JAMES K. STACE.

THE book on *12 strates Electrocardiography* by Bernstein is a small atlas containing approximately 100 plates representing an electrocardiogram or portions of multiple tracings. The first portion of the book illustrates the various types and normal electrocardiograms followed by a section on the

ILLUSTRATIVE ELECTROCARDIOGRAPHY. By Julius Bernstein, A.B. M.D. Originally written by the late Joseph H. Bernstein, A.B. M.D. and Julius Bernstein, B.S. M.D. 2d ed. New York and London: D. Appleton-Century Co. Inc. 1940.

arrhythmias. One section is devoted to block, and another to bundle branch block. There are excellent illustrations of the serial changes in acute coronary thrombosis and also of the effects of digitalis on the electrocardiogram. Fourth lead tracings are shown, illustrating acute coronary thrombosis and also the effects of digitalis.

Most of the electrocardiograms are exceptionally well chosen, and the illustrations are unusually clear and representative. The latter portion of the book the illustrations for the fourth lead are small and are not up to the standards in the other portions of the text. Some plates show several tracings with arrangement that may be confusing to the student. At the end of the book there is a very good index.

This book will be of interest to beginning students of electrocardiography who wish small atlas of representative electrocardiograms.

CRUCIFY C. MARIE.

## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

LA REACCION NO ARTERIO-URONIAL EN EL ESTENOLOSO PROCESO AGUDO DEL ANGIO. By Dr Emilio S. Sammartino. Buenos Aires: El Ateneo. 1940.

SYNOPSIS OF THE PRINCIPLES OF SCIENCE. By Jacob K. Betts, A.B. M.D. F.A.C.S. St. Louis: The C.V. Mosby Co., 1940.

A MANUAL OF OTOLARYNGOLOGY, RHEUMATOLOGY AND LARYNGOLOGY. By Howard Charles Baileger, M.D. F.A.C.S. Philadelphia: Lea & Febiger, 1940.

THE HEAD AND NECK IN RHEUMATOID DYSMETABOLISM. By Henry K. Fink, M.D., Eugene P. Fenderson, M.D., and J. Parsons Schaeffer, M.D. Philadelphia, Ill. and Baltimore: Charles C. Thomas, 1940.

PHYSIOLOGY. By Eugene C. Pittie, M.D. 2d ed. Philadelphia: F. A. Davis Co., 1940.

AN INTRODUCTION TO PHYSIOLOGY. TRANSLATED BY J. A. Gunn, M.A. M.D. D.Sc. F.R.C.P. 6th ed. London: Oxford University Press, 1940.

DISEASES OF THE NERVOUS SYSTEM. By W. Russell Brain, M.A. D.M. (Oxon.) F.R.C.P. (London). 2d ed. London: Oxford University Press, 1940.

THE EXPERIMENTAL ITCH; THE LESIONS CONSEQUENT TO FOLICULAR AFFECTION WITH SCABIES. By Robert Friedman, M.D. New York: Froben Press, 1940.

FR. HOWARD LARRY BERNARD. VOLUME. Springfield, Ill. and Baltimore, Md. Charles C. Thomas, 1940. MYOLOGY OF MEDICAL AND SURGICAL PRACTICE. Edited by J. C. Gelger, M.D. San Francisco: J. W. Stacy Inc., 1940.

TRABAJO DEL DEPARTAMENTO DE MATERIAS Y MEDICINA DEL HOSPITAL INTERNACIONAL DE CHILAS TRUJILLO, REPUBLICA DOMINICANA. Director: Dr. R. R. Cohen. Ciudad Trujillo: Editora Montalvo, 1940.

THE INJURED BACK AND ITS TREATMENT. Edited by John D. Ellis, M.D. Springfield, Ill. and Baltimore, Md. Charles C. Thomas, 1940.

HISTOLOGY OF THE PERIPHERAL AND CENTRAL NERVOUS SYSTEMS. By George B. Howell, M.D. 2d rev. ed. New York and London: Paul B. Hoeber Inc., 1940.

GYNECOLOGICAL AND OBSTETRICAL PHYSIOLOGY WITH CLINICAL AND EXPERIMENTAL RELATIONS. By Emil Novak, A.B. M.D. D.Sc. (Hon. Dublin) F.A.C.S. Philadelphia and London: W. B. Saunders Co., 1940.

ATLAS OF CARDIOVASCULOPATHOLOGY. By Hugo Rosendor, M.D. F.A.C.P. Springfield, Ill. and Baltimore, Md. Charles C. Thomas, 1940.

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

GEORGE P. MULLER, Philadelphia, *President*  
EVARTS A. GRAHAM, St. Louis, *President-Elect*

*Committee on Arrangements*

JOHN A. WOLFER, *Chairman*, CHARLES B. PUESTOW, *Secretary*

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## PROGRAM FOR THE CHICAGO CLINICAL CONGRESS

THE 1940 Clinical Congress of the American College of Surgeons will be held in Chicago, October 21-25. This will be the thirtieth assembly of this great organization of surgeons of the United States, Canada, and Latin America, the first of these meetings having been held in Chicago in 1910. The surgeons of this city are privileged to be hosts to this meeting for the eighth time since the Clinical Congress of Surgeons of North America initiated this vast educational program which places the primary emphasis upon well organized clinics conducted in the hospitals of a great medical center.

### CLINICAL PROGRAM

This year under the leadership of a strong and representative committee, it is planned to present a program of operative clinics and demonstrations in the five medical schools and forty or more approved hospitals which will constitute a highly organized postgraduate experience for all the surgeons who will attend. The operative clinics, demonstrations and exhibits in the hospitals will cover all phases of the clinical activities in the surgical and other departments of these institutions. Representing as it does the interests of all surgical specialists and general surgeons, this Congress will provide a complete and varied program during the five days of the meeting. There will be presentations of the latest advances in diagnostic methods, surgical techniques and operative procedures. Many of these presentations will deal with pertinent subjects related to pre- and post-operative care of the surgical patient.

The major feature of the Clinical Congress, as arranged by the local committee, will be an extensive schedule of operative clinics in which the technique of a wide variety of surgical procedures will be demonstrated in the operating rooms.

However, the program of each operative clinic has been planned with the idea of presenting related problems in diagnosis and other special aspects of the management of the surgical condition under consideration. In many of the clinics there will be an opportunity to observe the end-results which have been obtained following specific surgical treatment.

Non-operative clinics and demonstrations are being planned which present the various features of the clinical work which is being done in many of the hospitals and medical schools. Again, all of the special fields of surgery will be represented in this phase of the clinical program, which will provide an opportunity for surgeons engaged in various types of practice to study the latest advances in clinical surgery, as well as important research activities of the various hospitals and medical schools.

Several of the larger hospitals are planning special scientific exhibits. Thus the visiting surgeon will be able to study at first hand much of the clinical and experimental work which is being carried on by the surgeons of Chicago.

The program of each institution is being arranged to cover subjects in general surgery, fractures and other traumas, neurosurgery, orthopedic surgery, thoracic surgery, urology, obstetrics and gynecology, ophthalmology, and otorhinolaryngology. The clinical program, organized under this classification, is being so correlated that those attending the Congress will have ample opportunity to devote their time continuously to clinics dealing with subjects related to the specialty in which they are most interested. Clinics and demonstrations will be held on the afternoon of Monday, October 21, and the mornings and afternoons of each of the four succeeding days.

In order to aid the visiting surgeons in selecting

## CLINICAL CONGRESS PROGRAM IN BRIEF

(All sessions at the Stevens Hotel except as noted)

## Monday, October

- 100 Hospital Conference.
- 130 Panel Discussions (5)
- 100 Clinics in Chicago hospitals.
- 100 Hospital Conference.
- 100 Surgical Film Exhibition, General Surgery
- 1300 Assembly of Initiates, followed by reception—  
Headquarters of College
- 1330 Panel Discussions (5)
- 1800 Presidential Meeting and Convocation.

## Tuesday, October 22

- 900 Clinics in Chicago hospitals.
- 930 Hospital Conference.
- 930 Surgical Film Exhibition, Eye, Ear, Nose and  
Throat Surgery
- 100 Surgical Film Exhibition, General Surgery
- 100 Group Conferences, Eye, Ear, Nose and Throat  
Surgery ( )
- 130 Panel Discussions (5)
- 100 Clinics in Chicago hospitals.
- 100 Hospital Conference.
- 100 Symposium on Fractures and Other Traumas.
- 100 Surgical Film Exhibition, General Surgery
- 1330 Panel Discussions (5)
- 700 Surgical Film Exhibition, Eye, Ear, Nose and  
Throat Surgery
- 730 Hospital Conference
- 800 Scientific Session, General Surgery
- 800 Scientific Session, Ophthalmology
- 8300 Scientific Session, Otorhinolaryngology

## Wednesday, October 23

- 900 Clinics in Chicago hospitals
- 930 Hospital Conference.
- 930 Surgical Film Exhibition, Eye, Ear, Nose and  
Throat Surgery
- 930 State and Provincial Judiciary Committees.
- 100 State and Provincial Credentials Committees.
- 100 State and Provincial Executive Committees
- 100 Group Conferences, Eye, Ear, Nose and Throat  
Surgery ( )

- 100 Meeting of Board of Governors
- 130 Panel Discussions (5)
- 100 Clinics in Chicago hospitals.
- 100 Symposium on Cancer
- 100 Surgical Film Exhibition, General Surgery
- 130 Hospital Conference.
- 1330 Panel Discussions (5)
- 700 Surgical Film Exhibition, Eye, Ear, Nose and  
Throat Surgery
- 730 Hospital Conference
- 800 Scientific Session, General Surgery
- 800 Joint Session, Ophthalmology and Otolaryngology

## Thursday, October 24

- 900 Clinics in Chicago hospitals
- 930 Hospital Conference
- 930 Surgical Film Exhibition, Eye, Ear, Nose and  
Throat Surgery
- 100 Surgical Film Exhibition, General Surgery
- 100 Group Conferences, Eye, Ear, Nose and Throat  
Surgery ( )
- 130 Annual Meeting, Fellows of the College.
- 100 Clinics in Chicago hospitals
- 100 Hospital Conference
- 1300 Conference on Graduate Training in Surgery
- 1330 Panel Discussions (5)
- 1330 Surgical Film Exhibition, General Surgery
- 1330 National and Regional Fracture Committees
- 700 Surgical Film Exhibition, Eye, Ear, Nose and  
Throat Surgery
- 800 Scientific Session, General Surgery
- 800 Scientific Session, Ophthalmology
- 800 Scientific Session, Otorhinolaryngology

## Friday, October 25

- 900 Clinics in Chicago hospitals.
- 930 Surgical Film Exhibition, Eye, Ear, Nose and  
Throat Surgery
- 100 Surgical Film Exhibition, General Surgery
- 100 Clinics in Chicago hospitals.
- 1300 Group Clinical Conferences (7).
- 100 Surgical Film Exhibition, General Surgery

the clinics which they desire to attend the *Daily Clinical Bulletin* will present the program according to the foregoing classification. The complete details of the clinical program for the following day will be posted each afternoon in the form of bulletins at headquarters in the Stevens Hotel. The *Daily Bulletin* will be distributed in printed form each morning during the Congress.

## EVENING SCIENTIFIC SESSIONS

The opening scientific session of the Clinical Congress will be held on Monday evening in the Ballroom of the Stevens Hotel, when the Presidential Meeting and Convocation will be combined. The new officers of the College will be inaugurated and the 940 class of Initiates received into fellowship. Distinguished surgeons from foreign countries will then be introduced, following which

Dr. George P. Muller of Philadelphia, will deliver the presidential address. Principles of Colonic Surgery will be the subject of the sixth annual oration on surgery to be delivered by Dr. Fred W. Rankin, Lexington, Kentucky.

Scientific meetings will be held on Tuesday, Wednesday and Thursday evenings at the headquarters hotel when distinguished members of the profession of international prominence will address the assembled guests of the Congress. The speakers and subjects of these addresses have been carefully selected in order to assure presentations which will be of interest to those who are practicing in all of the special fields of surgery. This program has been prepared by the Board of Regents of the College in order to give consideration to as many of the latest advances in general surgery and the surgical specialties as possible.

## PROGRAM FOR THE CHICAGO CLINICAL CONGRESS

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These scientific papers will be of such importance as to represent outstanding contributions to the surgical literature

### PANEL DISCUSSIONS

Panel discussions have met with such decided success at the Clinical Congress and in the sectional meetings of the College that the schedule this year will include an elaboration of this phase of the program as it is arranged for Monday, Tuesday, Wednesday, and Thursday afternoons. Recognized authorities in special fields are co-operating with the College as leaders and collaborators of these panels, and the topics which have been selected cover many pertinent subjects. This type of program permits more informal discussion of the subject than would be possible in the larger meetings. The plan provides that the leader will present his subject within a ten minute period, briefly, after which general discussion from the floor will be encouraged.

### GROUP CLINICAL CONFERENCES

A new feature of considerable interest to all surgeons attending the Congress will be the series of group clinical conferences which is being arranged for Friday afternoon. Nine special fields of surgery have been selected and an important subject of current interest will be briefly presented in each conference. These special fields are Fractures and other traumas, neurosurgery, obstetrics and gynecology, orthopedic surgery, plastic surgery, thoracic surgery, and urology. The leaders are selecting the subjects which will be presented. They will direct discussions from the floor and visitors attending the meeting will be invited to present any problem with which they may be concerned—one that is related to the special field under discussion. Recognized authorities will endeavor to answer these questions and offer as much helpful advice as possible. Everyone should benefit by participating in a consultation conference of this nature.

### SYMPOSIUM ON CANCER

The Cancer Committee of the College has done outstanding work in furthering the development of cancer clinics in hospitals and providing for the registration of cured cases of malignant disease in the cancer archives. The chairman of this committee will give a brief review of these activities of the College in opening the symposium on cancer which will be held Wednesday afternoon. Other subjects of practical interest which will be presented include various problems in the diagnosis

and treatment of "Neurogenic Sarcoma" and "Pelvic Cancer." In addition, one speaker will discuss "The Present Status of Carcinogens and Hormones in Cancer Research" and another will lead a discussion on the subject of "Radiation Damage of Tissue and Its Repair." In this symposium the surgeon, the pathologist and the radiologist will discuss important aspects of the cancer problem which are of current interest.

### SYMPOSIUM ON FRACTURES AND OTHER TRAUMAS

In this symposium, to be held on Tuesday afternoon, the Chairman of the committee will make a brief statement concerning the work which has been done during the past year by the national and regional fracture committees. The scientific papers to be presented at this meeting will emphasize practical subjects dealing with different types of fractures which present special problems in management and treatment. One of the papers will deal particularly with "Undergraduate Education in Fractures and Other Traumas." The program will be of interest to all surgeons who engage in this type of practice and will afford an opportunity for them to learn different viewpoints regarding the handling of many clinical problems.

### OPHTHALMOLOGY AND OTOLARYNGOLOGY

A new departure from the proceedings of the Congress in former years is being arranged in ophthalmology and otolaryngology. Separate sessions scheduled for Tuesday and Thursday evenings will include panel discussions and symposia on important subjects in these fields. The leaders and a group of outstanding surgeons will direct the discussions in these meetings so as to cover many phases of a general subject in each of the specialties and a number of different viewpoints will be expressed. On Wednesday evening, there will be a joint session of ophthalmologists and otolaryngologists with a symposium on the important subject "Primary Treatment of Injuries about the Face." An ophthalmologist, an otolaryngologist, a maxillofacial surgeon, and a neurosurgeon will cover all aspects of this subject. This type of program promises to attract wider interest than the usual presentation of formal papers.

Clinics in Chicago hospitals each morning and afternoon for the visiting ophthalmologists and otolaryngologists will demonstrate surgical work of a wide variety. On Tuesday, Wednesday, and Thursday mornings, in addition to the hospital program, there will be clinical conferences for each group of specialists at the headquarters hotel. These are being arranged so that the leader will

briefly survey the field for discussion in a ten minute period. The large meeting of surgeons will then be broken up into small groups, limited to 20 and under separate leaders, where there will be an opportunity for everyone to ask questions and participate in the discussions. Each visitor will select in advance the small section of the meeting which he wishes to attend. In this manner the general subject may be discussed thoroughly and each will benefit by the experience and different viewpoints of his colleagues. The success of these conferences is assured. The morning and evening meetings will be preceded by the showing of selected surgical motion picture films.

#### GRADUATE TRAINING IN SURGERY

Following the annual meeting of the fellows to be held on Thursday afternoon there will be a panel discussion on graduate training in surgery. The chairman of the committee of the College which represents the surgical specialist as well as the general surgeon, will summarize the work which has been done during the past three years. Following this report, there will be one formal paper dealing with plans of graduate training in surgery in hospitals which have no direct medical school affiliations. The teaching methods employed in educational programs in institutions of this type will be described in detail. The meeting will then be turned over to informal discussions from the floor. The leader will direct these discussions on the problems presented in developing graduate training in hospitals where undergraduate teaching may be limited or entirely lacking. This program should elicit the interest of all hospital executives, surgeons, and educators who are concerned with the future standards of surgery in the United States and Canada.

#### ASSEMBLY OF INITIATES

On Monday afternoon in the Auditorium of the American College of Surgeons headquarters at 40 East Erie Street, there will be held the Assembly of Initiates. This meeting will be presided over by Dr. George P. Muller, President of the College, and Dr. Arthur W. Allen, Boston, Vice Chairman of the Board of Regents. Dr. Bowman C. Crowell and Dr. Malcolm T. MacEachern will discuss "The Program of the American College of Surgeons." Initiates will then recite the Fellowship Pledge and greetings will be extended by Dr. Evans A. Graham, St. Louis, President Elect of the College. Closing remarks will be made by Dr. Irvin Abel, Chairman of the Board of Regents. Following the adjournment of this assembly a reception for the initiates, their wives and friends

will be held by the officers and Regents of the College.

#### MEETING OF NATIONAL AND REGIONAL FRACTURE COMMITTEES

The meeting of the National and Regional Fracture Committees will be held on Thursday afternoon, when this large body of surgeons will assemble for a discussion of the activities of the respective groups. Working in co-operation with the American Red Cross, other local organizations and public officials, these committees have exerted great influence in providing improved methods and facilities for the transportation of the injured. There has also been a concerted effort to improve the treatment of fractures in the hospitals of all communities.

#### ANNUAL MEETINGS OF COMMITTEES

The annual meetings of the State and Provincial Judiciary, Credentials, and Executive Committees will be held on Wednesday morning. These committees have an important function to perform in the activities of the College. The Credentials Committees and the Committees on Applicants provide an organization which constitutes one of the largest and most carefully deliberate accrediting bodies which exist in the medical profession. Through this organization, the standards of fellowship are maintained and each fellow of the College has definite responsibility in this work. All members of each of these committees are urged to attend these important sessions.

#### ANNUAL MEETING OF THE FELLOWS

The annual meeting of the fellows will be held on Thursday afternoon. The American College of Surgeons has been a potent force which has not only materially raised the professional and ethical standards of surgery but has also promoted good hospitalization and general improvement in the practice of medicine in the United States and Canada. These activities have received wide recognition by professional groups and the public as well. Each individual fellow of the College has a part in this work and may extend its influence materially in his local community. Hospital standardization alone offers him unlimited opportunity to provide better medical care for his patients in the hospital in which he works through continuous progress in applying the principles of the minimum standard. Approval of hospitals, plans for graduate training in surgery, cancer clinics, medical service in industry, medical motion pictures, the Clinical Congress, and sectional meetings present a vast educational program.

The annual meeting of the Fellows affords the officials of the College an opportunity to report on the activities of the organization and to receive suggestions from those who have made possible the conduct of these activities. Every fellow of the American College of Surgeons will want to attend this important meeting and participate in the program.

## MEDICAL MOTION PICTURES

An enlarged program of surgical motion pictures will be presented at headquarters which will include the latest available films on a wide variety of subjects of interest to the surgeon. The schedule will be arranged so as not to conflict with either the clinical program at the hospitals or the scientific sessions and will include both sound and silent, standard and color films which have been approved by the College Committee on Medical Motion Pictures.

## HOSPITAL CONFERENCES

The twenty-third annual hospital standardization conference will open the Clinical Congress with a meeting at the headquarters hotel on Monday morning at 10 00 o'clock. The report of the 1940 hospital standardization survey—official announcement of the list of approved hospitals and hospitals approved for graduate training in surgery—will be made at this session. In addition, there will be a very interesting discussion on "Medical Preparedness in the Case of a War Emergency." The Surgeon General of the United States Navy, Admiral Ross T. McIntire, will give a brief address and E. W. Jones, Superintendent of the Albany Hospital, Albany, New York, will present the plan which has been developed in this hospital for organizing the entire personnel in case of such an emergency.

The afternoon session on Monday will be given over to significant discussions on convalescent care. The subject will be presented from the sociological and economic viewpoints by leading surgeons and others who have had experience with this problem in their respective communities. Fundamental principles in organizing for adequate convalescent care of the surgical patient will be emphasized.

The Tuesday morning session of the hospital conference will include three important panel discussions: "The Control of Surgery," led by Dr. Harold Foss of Danville, Pennsylvania, "The Control of Infections," led by Dr. Frank L. Meloney of New York, and "The Physical and Administrative Hazards of Anesthesia," led by Dr. John S. Lundy of Rochester, Minnesota.

These important panels will be interesting to both hospital visitors and fellows of the College. The afternoon session on Tuesday will be devoted to a discussion of "Nursing in the Hospital." There will be a discussion of "The Essentials of Good Nursing Service," followed by a panel discussion on "Administrative Costs of Nursing in Hospitals." A keenly debated subject will also be brought up for discussion, namely, "The Accrediting of Schools of Nursing Education." There will be a panel round table conference on Tuesday evening which will cover all phases of organization, professional practice and public relations. This session should arouse the interest of all hospital visitors, particularly those who are charged with the responsibility of administration in the small hospital.

On Wednesday morning, at a joint session with the American Association of Medical Record Librarians, there will be a discussion of "The Adoption of the Standard Nomenclature," "The Proposal of a Surgical Nomenclature," "The Punch Card System," and "The Relationship of the Medical Record Librarian to the Medical Staff." These subjects present pertinent problems in the organization of a medical records department in the hospital. The afternoon session on Wednesday will be devoted to demonstrations and group conferences covering administrative practices and professional procedures held in ten of the leading approved hospitals of the Chicago area. On Wednesday night the panel discussions will provide a means for presenting specific questions on hospital procedures to a group of leaders in the hospital field.

On Thursday morning the panel discussion will deal principally with the care of tuberculosis patients in general hospitals, the relation of the administration of the hospital to organized medicine, medical staff organization, health service for hospital personnel, and the cost of hospital care. The conference will close on Thursday afternoon with a series of group conferences and demonstrations dealing with administrative and professional practices in leading Chicago institutions.

A new feature has been added to the hospital conferences this year—on Tuesday, Wednesday, and Thursday mornings there will be held breakfast conferences commencing at 7 45 a m and ending promptly at 9 15. While breakfast is being served, there will be an opportunity for those attending to participate in a free and animated discussion of each subject under consideration. Each morning ten minutes will be allowed for the speaker to present his subject, following which each one in attendance will be called upon to give



his reaction to the matter under discussion. The subjects will be: Tuesday morning "The Hospital Administrator's Program for Self Development." Wednesday morning "The Medical Records Librarian's Program for Self Development." Thursday morning "The Public Relations Program of Your Hospital." As the attendance at these meetings will be limited there will be arrangements for advance registration.

Perhaps the most important feature of the hospital conference will be the daily consultation service which will be provided. The information desks will be in charge of personnel of the Hospital Standardization Department of the College who will arrange for consultations on hospital problems with the field representatives of the organization and others who will be able to give authoritative information on various subjects. All who attend the hospital conferences are urged to present their particular problem and avail themselves of this service.

#### ADVANCE REGISTRATION

The hospitals and medical schools of the Chicago area afford accommodations for a large number of visiting surgeons, but to insure against overcrowding attendance at the Congress will be limited to the number that can be comfortably accommodated at the clinics. The limit of attendance will be based on a survey determining the available facilities in the participating institutions. It is expected therefore that surgeons who wish to attend the Congress will register in advance.

A registration fee will be required in order to provide funds with which to meet expenses of the meeting. A formal receipt will be issued to each surgeon registering in advance which will be exchanged for a general admission card upon presentation at headquarters during the Congress. This card, which is not transferable, must accompany all requests for clinic tickets and be presented for admission to the scientific sessions.

A resolution adopted by the Board of Regents provides that the registration fee for fellows of the College and endorsed junior candidates shall be \$5.00; that no fee for the 1950 Clinical Congress shall be required of Initiates (class of 1949) that the fee for surgeons who are not Fellows attending as invited guests of the College shall be \$1.00.

As in previous years, admission to clinics and demonstrations in the hospitals and certain of the

scientific meetings at headquarters will be controlled by means of tickets. This plan provides for the distribution of visiting surgeons at the various clinics and other meetings and helps to insure against overcrowding. The number of tickets issued for any clinic will be limited to the capacity of the room in which the clinic is held. Visiting surgeons are urged to co-operate in making the clinic ticket plan a success.

#### HEADQUARTERS—TECHNICAL EXHIBITION

Headquarters for the Congress will be established at the Stevens Hotel where there are unusual facilities for accommodating the Congress. All of the public rooms have been reserved for conferences, registration, ticket bureaus, clinic bulletins, executive offices and scientific exhibits. Thus, all activities of the Congress, except the clinical program, will be located under one roof.

The technical exhibition together with the registration desk will be located on the lower floor of the Stevens Hotel in the large exhibition hall. Leading manufacturers of surgical instruments and supplies, sutures, dressings, pharmaceuticals, operating room equipment, x-ray apparatus and hospital equipment of all kinds, as well as publishers of medical books, will be represented in the exhibition. It will provide for the visiting surgeons an opportunity of carefully inspecting the finest modern products of all these industries which are aiding the work of the surgeon and the hospital.

#### CHICAGO HOTELS AND THEIR RATES

In addition to the headquarters hotel the Stevens, there are several first-class hotels within short walking distance of headquarters, providing ample hotel facilities at reasonable rates. It is suggested that reservation of hotel accommodations be made at an early date. The following hotels are recommended by the Committee:

	Minimum Rate with Bath	Double
Andersson, 430 S. Michigan Ave.	\$2.50	\$4.00
Bismarck, 71 W. Randolph St.	3.50	5.00
Blackstone, Michigan Ave. at 7th St.	4.00	6.00
Congress, 300 S. Michigan Ave.	3.00	5.00
Drake, Michigan and Lake Shore Drv.	4.00	6.00
Harrison, 57 E. Harrison St.	00	3.00
Lake Shore Drive, 1 Lake Shore Drive	4.00	6.00
LaSalle, N. LaSalle St.	3.00	4.00
Morrison, 79 W. Madison St.	3.00	4.00
Palmer House, 4 E. Monroe St.	3.50	5.00
Sherman, 100 W. Randolph St.	3.50	4.00
Stevens, 730 S. Michigan Ave.	3.00	4.50

PROGRAM FOR THE CHICAGO CLINICAL CONGRESS

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COMMITTEE ON ARRANGEMENTS

EXECUTIVE COMMITTEE

John A. Wolfer  
Chairman  
Charles B. Puestow  
Secretary  
Fred L. Adair  
William E. Adams  
William J. Baker  
Frederic A. Besley  
Alexander Brunschwig  
Fremont A. Chandler

Warren H. Cole  
Vernon C. David  
Marshall Davison  
Harry S. Gradle  
Michael L. Mason  
Oscar E. Nadeau  
Eric Oldberg  
Samuel Salinger  
Charles F. Sawyer  
Kellogg Speed

HOSPITALS AND REPRESENTATIVES

Alexian Brothers—George L. Apfelbach  
Augustana—Oscar E. Nadeau  
Albert Merritt Billings and Bobs Roberts Memorial—  
Dallas B. Phemister  
Chicago Lying in—Fred L. Adair  
Chicago Memorial—Peter S. Clark  
Children's Memorial—Albert H. Montgomery  
Columbus—Daniel A. Orth  
Cook County—Marshall Davison  
Evangelical—G. Henry Mundt  
Evanston—Frederick Christopher  
Grant—A. G. Zimmerman  
Henrotin—John A. Graham

Holy Cross—John F. Ruzic  
Illinois Eye and Ear Infirmary—Thomas D. Allen  
Illinois Masonic—Walter C. Bornemeier  
Jackson Park—Arrie Bamberger  
Loretto—James A. Valentine  
Mercy—Charles F. Sawyer  
Michael Reese—Ralph B. Bettman  
Mother Cabrini—Eugene J. Chesron  
Mount Sinai—Jacob M. Mora  
Municipal Tuberculosis Sanitarium—Richard Davison  
Norwegian American—Harold A. Sofield  
Passavant Memorial—Loyal Davis  
Presbyterian—Vernon C. David  
Ravenswood—Darwin B. Pond  
Research and Educational—Warren H. Cole  
St. Anne's—George F. Thompson  
St. Anthony de Padua—Frederick W. Slobe  
St. Bernard's—John G. Frost  
St. Elizabeth's—Martin G. Luken  
St. Joseph—Hugh McKenna  
St. Luke's—Selun W. McArthur  
St. Mary of Nazareth—George M. Mueller  
Shriners' for Crippled Children—Beveridge H. Moore  
Swedish Covenant—Karl L. Vehe  
Veterans Administration—Paul F. Brown  
Washington Boulevard—Arthur R. Metz  
Wesley Memorial—Raymond W. McNealy  
Women and Children's—Maude H. Winnett

## PROGRAMS FOR EVENING SESSIONS

*Presidential Meeting and Convocation—Monday 8 on p.m.—Ballroom Stevens Hotel*

GEORGE P. MULLER, M.D. Philadelphia President American College of Surgeons, Presiding  
 Processional—Officers, Regents, and Honorary Guests.

Invocation.

Address of Welcome JOHN A. WOLFF, M.D. Chicago Chairman, Committee on Arrangements.  
 Introduction of Foreign Guests.

Address of Retiring President GEORGE P. MULLER, M.D. Philadelphia.

Inauguration of Officers.

President EVARTS A. GRAHAM, M.D. St. Louis.

First Vice President OLIVER S. WATSON, M.D. Winnipeg.

Second Vice President ALBERT O. SINGLETON, M.D. Galveston.

Presentation of Initiates for Fellowship. I. VIN ARTELL, M.D. Louisville Chairman, Board of Regents.

Conferring of Fellowships by the President. EVARTS A. GRAHAM, M.D. St. Louis.

Conferring of Honorary Fellowships. The President.

Medical Records Prime A and.

Annual Oration on Surgery Principles of Colonic Surgery FRED W. RANNEY, M.D. Lexington.

*Tuesday 8:00 p.m.—Ballroom Stevens Hotel*

EVARTS A. GRAHAM, M.D. St. Louis President, American College of Surgeons, Presiding

Surgical Complications in Pregnancy JOHN R. FRASER, M.D. Montreal.

Aseptic Resections in the Gastrointestinal Tract, with Special Reference to Resection of the Stomach.  
 OWEN H. WASHBURN, M.D. Minneapolis.

Symposium The Esophagus.

Observations on the Diagnosis and Treatment of Caustic Burns, Esophageal Stenosis and Achalasia.  
 GABRIEL TUCKER, M.D. Philadelphia.

Surgical Treatment of Achalasia. ALTON OCHSNER, M.D. and MICHAEL E. D. BAILEY, M.D. New Orleans.

Recent Progress in the Surgical Treatment of Carcinoma of the Esophagus WILLIAM E. ADAMS, M.D. Chicago.

*Wednesday 8 on p.m.—Ballroom Stevens Hotel*

OLIVER S. WATSON, M.D. Winnipeg Vice President, American College of Surgeons, Presiding

Sulfonamide Therapy as an Aid to Surgery JOHN S. LOCKWOOD, M.D. Philadelphia

Oration on Traumatic Surgery Treatment of Traumas of Skin and Subcutaneous Tissues FREDERIC W. BALCHROFT, M.D. New York.

The Civilian Surgeon in War BRIGADIER GENERAL RAYMOND F. MITCHELL, M.C. U.S.A. Washington

A Brief Statement of the Work of the National Research Council Committee on Surgery Connection with the Program of Military Preparedness EVARTS A. GRAHAM, M.D. St. Louis.

*Thursday 8:00 p.m.—Ballroom Stevens Hotel*

ALBERT O. SINGLETON, M.D. Galveston Vice President, American College of Surgeons, Presiding

Gastrojejunocolic Fistula. DAMON B. PYLITZER, M.D. Philadelphia

Some Factors Influencing the Curability of Cancer of the Stomach THOMAS F. MILLER, M.D. San Francisco.

The Management of the Neurogenic Bladder in Traumatic Lesions of the Spinal Cord and Cauda Equina.  
 REED M. VASERT, M.D. Ann Arbor Mich.

Heparin in Thrombosis and Blood Vessel Surgery D. W. GORDON MITCHELL, M.D. Toronto.

PROGRAM FOR THE CHICAGO CLINICAL CONGRESS

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PROGRAMS FOR EVENING SESSIONS

OPHTHALMOLOGY

*Tuesday, 8 00 p m —Stevens Hotel*  
Panel Discussion Surgery of Squint WILLIAM THORNWALL DAVIS, M D , Washington, Presiding  
Collaborators F BRUCE FRALICK, M D , Ann Arbor, Mich , SANFORD R. GIFFORD, M D , Chicago

*Thursday, 8 00 p m —Stevens Hotel*  
SANFORD R GIFFORD, M D , Chicago, Chairman, Advisory Council for Ophthalmology, Presiding  
Symposium Advances of the Past Ten Years in Ophthalmic Surgery  
Principles of Cataract Surgery JOHN H DUNNINGTON, M D , New York  
Glaucoma Surgery ALGERNON B REESE, M D , New York  
Retinal Detachment Surgery DERRICK T VAIL, JR , M D , Cincinnati

OPHTHALMOLOGY AND OTORHINOLARYNGOLOGY

*Wednesday, 8 00 p m —Stevens Hotel*  
HARRY S GRADLE, M D , Chicago, Regent, American College of Surgeons, Presiding  
Symposium Treatment of Injuries about the Face  
The Treatment of Injuries of the Globe and the Lids, and the Orbit EDMUND B SPAFTH, M D ,  
Philadelphia  
Primary Care of Injuries of the Face and Jaws V H KAZANJIAN, M D , Boston  
The Late Care of Severe Injuries of the Face and Jaws EARL C PADGETT, M D , Kansas City, Mo  
Neurosurgical Aspects of Facial Injury HARRY H KERR, M D , Washington

OTORHINOLARYNGOLOGY

*Tuesday, 8 00 p m —Stevens Hotel*  
SAMUEL SALINGER, M D , Chicago, Member, Executive Committee on Arrangements, Presiding  
Symposium Meniere's Disease  
Medical Treatment of Meniere's Disease HAROLD G TOBEY, M D , Boston  
The Use of Histamine in Meniere's Disease BAYARD T HORTON, M D , Rochester, Minn  
The Surgical Treatment of Meniere's Disease WALTER E DANDY, M D , Baltimore  
General Discussion

*Thursday 8 00 p m —Stevens Hotel*

PERRY G GOLDSMITH, M D , Toronto, Chairman, Advisory Council for Otorhinolaryngology, Presiding  
Body Section Roentgenography in Relation to Diagnosis in Diseases of the Nasal Accessory Sinuses  
SHIRWOOD MOORE, M D , and ALFRED J COVE, M D , St Louis  
Tumors of the Upper Jaw, Particularly in Relation to the Sinuses CARL W WALDRON, M D , Minneapolis  
History and Present Status of Operations on the Labyrinthine Capsule for Otosclerosis SAMUEL J  
KOPETZKA, M D , New York

## PROGRAMS FOR AFTERNOON SESSIONS

## SYMPOSIUM ON FRACTURES AND OTHER TRAUMAS

*Tuesday 2:00 p.m. — Stevens Hotel*

ROBERT H. KENNEDY, M.D., New York, Chairman, Committee on Fractures and Other Traumas, Presiding.  
 End Results of Fractures of the Tibia and Fibula Treated by Skeletal Traction and Braun Böhler Splint.  
 HUBLEY R. OWEN, M.D., Philadelphia

Fractures Due to Muscular Violence. FRANK P. STRICKLER, M.D., Louisville

Undergraduate Education in Fractures and Other Traumas. CLAY RAY MURRAY, M.D., New York.

Extradural Hemorrhage Following Trauma. J. DERYL HART, M.D., and BARNES WOODHALL, M.D., Durham, N. C.

Fractures Involving the Ankle Joint. RALPH G. CAROTHERS, M.D., Cincinnati.

## SYMPOSIUM ON CANCER

*Wednesday 2:00 p.m. — Stevens Hotel*

FRANK E. ADAMS, M.D., New York, Chairman, Cancer Committee, Presiding.

Neurogenic Sarcoma. DONALD A. T. CRAWFORD, M.D., Seattle.

Present Status of Carcinogens and Hormones in Cancer Research. JOHN J. MORTON, M.D., Rochester, N. Y.

Radiation Damage to Tissues and Its Repair. ERNEST M. DALAND, M.D., Boston.

Pelvic Cancer. GEORGE KAMPERMAN, M.D., Detroit.

## GROUP CLINICAL CONFERENCES

## GENERAL SURGERY AND SURGICAL SPECIALTIES

*Friday 2:00 p.m. — Stevens Hotel*

The Management of Uterine Prolapse. LOUIS E. PHAFFY, M.D., Boston, Presiding.

Deformities of the Ear: Congenital and Acquired. H. L. D. KIRKHAM, M.D., Houston, Presiding.

Major Trigeminal Neuralgia. FRANCIS C. GRANT, M.D., Philadelphia, Presiding.

Diagnosis and Treatment of Intrathoracic Tumors. FRANK S. DOLLEY, M.D., Los Angeles, Presiding.

Malignancies of the Kidney and Ureter. T. LEO H. WARD, M.D., Denver, Presiding.

Treatment of Compound Fractures. GUY A. CALDWELL, M.D., New Orleans, Presiding.

## OPHTHALMOLOGY AND OTORHINOLARYNGOLOGY

*Tuesday 2:00 p.m. — Stevens Hotel*

Surgical Indications in Glaucoma. HARRIS S. GRADIS, M.D., Chicago, Presiding.

Role of Chemotherapy in Suppurative Diseases of the Middle Ear. JAMES J. SEXTA, M.D., Memphis, Presiding.

*Wednesday 2:00 p.m. — Stevens Hotel*

Surgical Management of Epiptosis of the Eye. ARTHUR M. C. KELL, M.D., Dayton, Ohio, Presiding.

Indications for Surgery in Sinus Disease. SAMUEL I. LAYMAN, M.D., Cincinnati, Presiding.

*Thursday 2:00 p.m. — Stevens Hotel*

Minor Surgery in Ophthalmology. MERVIN B. KELL, M.D., St. Louis, Presiding.

Osteomyelitis of the Skull Bones (Sinus and Mastoid Complication). IRVING E. COOPER, M.D., Denver, Presiding.

## PANEL DISCUSSIONS

*Monday, 1 30 to 3 00 p m —Stevens Hotel*

- Treatment of Acute Cholecystitis JOHN L ATLEE, JR, M D, Lancaster, Pa, Presiding  
 Collaborators FREDERICK E KREDEL, M D, Charleston, S C, KENT W BARBER, M D, Quincy, Ill,  
 J LOUIS RANSOHOFF, M D, Cincinnati
- Dislocation of the Intervertebral Disc FRANK D DICKSON, M D, Kansas City, Mo, Presiding  
 Collaborators W JASON MIXTER, M D, Boston, LLOYD NOLAND, M D, Fairfield, Ala, LEWIS J POLLOCK,  
 M D, Chicago
- The Treatment of Endocrine Sterility in Woman EDWIN C HAMBLEN, M D, Durham, N C, Presiding  
 Collaborators JOHN C BURCH, M D, Nashville, CONRAD G COLLINS, M D, New Orleans
- Complications of Thyroid Surgery FRANK H LAHEY, M D, Boston, Presiding  
 Collaborators HAROLD L FOSS, M D, Danville, Pa, S L LEDBETTER, JR, M D, Birmingham, H H  
 SEARLS, M D, San Francisco
- The Place of Irradiation Treatment in Cancer of the Breast EUGENE P PENDERGRASS, M D, Philadelphia,  
 Presiding  
 Collaborators FRANK E ADAIR, M D, New York, ALSON R KILGORE, M D, San Francisco, JAMES  
 F KELLY, M D, Omaha, STUART W HARRINGTON, M D, Rochester, Minn

*Monday, 3 30 to 5 00 p m —Stevens Hotel*

- Abdominal Traumas FREDERIC A BESLEY, M D, Waukegan, Presiding  
 Collaborators JOHN H MULHOLLAND, M D, New York, FRED W BAILEY, M D, St Louis, AMBROSE  
 H STORCK, M D, New Orleans
- Carcinoma of the Colon FREDERICK A COLLIER, M D, Ann Arbor, Mich, Presiding  
 Collaborators VERNON C DAVID, M D, Chicago, CLAUDE F DIXON, M D, Rochester, Minn, THOMAS  
 E JONES, M D, Cleveland
- Indications for Cesarean Section S A COSGROVE, M D, Jersey City, N J, Presiding  
 Collaborators JAMES RAGLAN MILLER, M D, Hartford, H HUDNALL WARE, JR, M D, Richmond
- Management of Acute Perforated Appendicitis VERNE C HUNT, M D, Los Angeles, Presiding  
 Collaborators LAWRENCE S FALLIS, M D, Detroit, WILLIS D GATCH, M D, Indianapolis, HENRY K  
 RANSOM, M D, Ann Arbor, Mich
- Subacromial Bursitis HENRY W MEYERDING, M D, Rochester, Minn, Presiding  
 Collaborator EARL D McBRIDE, M D, Oklahoma City

*Tuesday, 1 30 to 3 00 p m —Stevens Hotel*

- Atypical Giant Cell Tumors of Bone BRADLEY L COLEY, M D, New York, Presiding  
 Collaborator DALLAS B PHEMISTER, M D, Chicago
- Nutritional State of the Patient (Vitamins, Proteins) L KRAEER FERGUSON, M D, Philadelphia, Presiding  
 Collaborators JOHN B HARTZELL, M D, Detroit, A C IVY, M D, Chicago, CHARLES C LUND, M D,  
 Boston
- Management of Infections of the Urinary Tract CHARLES C HIGGINS, M D, Cleveland, Presiding  
 Collaborators HENRY O MERTZ, M D, Indianapolis, JOHN K ORMOND, M D, Detroit, IRA R SISK,  
 M D, Madison, Wis
- Acute Abdominal Surgery in Children THOMAS H LANMAN, M D, Boston, Presiding  
 Collaborators EDWARD J DONOVAN, M D, New York, WALTER ESTELL LEE, M D, Philadelphia, W J  
 PORTS, M D, Oak Park, Ill
- Tumors of the Salivary Glands ALBERT O SINGLETON, M D, Galveston, Presiding  
 Collaborators EDWIN I BARTLETT, M D, San Francisco, FREDERICK A FIGI, M D, Rochester, Minn,  
 R B MALCOLM, M D, Chicago

*Tuesday 3:30 to 5:00 p.m. — Stevens Hotel*

Surgery in Pulmonary Tuberculosis. LEO ELOEGER, M.D. San Francisco, Presiding

Collaborators CASPER F. HENNER, M.D. Denver RICHARD H. MEADE, JR., M.D. Philadelphia VICTOR STROG. RANDOLPH M.D. Phoenix, Ariz.

Earl Recognition of Cancer of the Uterine Cervix and of the Corpus. WILLIAM P. HEALY, M.D. New York, Presiding.

Collaborators NORMAN F. MILLER, M.D. Ann Arbor Mich. FRED J. TAUBERT, M.D. St. Louis RAYMOND E. WATKINS, M.D. Portland, Ore.

Intestinal Obstruction. THOMAS G. ORR, M.D. Kansas City Mo., Presiding.

Collaborators M. J. HENRY, M.D. Louisville CHARLES G. JOHNSTON, M.D. Detroit MILES GAGE, M.D. New Orleans.

Surgical Diseases of the Pancreas. ALLEN O. WHIFFLE, M.D. New York, Presiding.

Collaborators ALEXANDER BRODSKI, M.D. Chicago JOHN MILTON McCARTHY, M.D. St. Louis.

*Wednesday 3:30 to 5:00 p.m. — Stevens Hotel*

Tumors of the Urinary Bladder. HENRY G. BUONICCONTI, M.D. New York, Presiding.

Collaborators LOUIS M. ORR, M.D. Orlando, Fla. CARL RECHT, M.D. Los Angeles.

Etiology and Treatment of Gastric Hemorrhage. ROSCOE R. GRAYMAN, M.D. Toronto, Presiding.

Collaborators HOWARD M. CLUTE, M.D. Boston J. WILLIAM HENTON, M.D. New York J. SWETLOW HORSLEY, M.D. Richmond.

Anesthesia in Cranial Surgery. GILBERT H. REAY, M.D. Boston, Presiding.

Collaborators JOHN S. LUND, M.D. Rochester Minn. MAX MINOR PERL, M.D. Ann Arbor Mich.

Healing of Wounds. SUMNER L. KOCH, M.D. Chicago, Presiding.

Collaborators LAWRENCE CHAFFIN, M.D. Los Angeles R. ARNOLD GRISWOLD, M.D. Louisville EDWARD L. HOWES, M.D. Washington.

Liver Tests and Liver Function in Relation to Biliary Surgery. I. S. RAVDIN, M.D. Philadelphia Presiding.

Collaborators HENRY W. CATHART, M.D. New York HOWARD K. GRAY, M.D. Rochester Minn. CHARLES B. PRYSTOW, M.D. Chicago.

*Wednesday 3:30 to 5:00 p.m. — Stevens Hotel*

Penetrating Wounds of the Brain. C. C. COLDMA, M.D. Richmond, Presiding.

Collaborators WILLIAM B. HARRY, M.D. Buffalo H. WARD C. NAPPZDER, M.D. San Francisco BYRON STOOKAY, M.D. New York.

Infections of the Hand. MICHAEL L. MASON, M.D. Chicago Presiding.

Collaborators HENRY H. HODGES, M.D. Seattle HENRY C. MARBLE, M.D. Boston J. M. WINFIELD, M.D. Detroit.

Surgical Bacteriology. FREDERICK L. MELEBY, M.D. New York, Presiding.

Collaborators EDWARD ANDERSON, M.D. Bloomington Ill. J. D. RYLAND, M.D. Durham, N. C. WILLIAM A. AUSTIN, M.D. Cincinnati.

Immediate Treatment of Burns. CROVER C. PERKINS, M.D. Detroit, Presiding.

Collaborators EDMUND BUTLER, M.D. San Francisco HARRY C. HULL, M.D. Baltimore DONALD B. WELLS, M.D. Hartford.

Anesthesia. Abdominal Surgery. ERWIN R. SCHMIDT, M.D. Madison, Wis. Presiding.

Collaborators VIRGINIA ARCA, M.D. New York CHESTER J. BUTLER, M.D. Chicago F. W. HARTMAN, M.D. Detroit.

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*Thursday, 3 30 to 5 00 p m — Stevens Hotel*

Anesthesia, Analgesia, and Amnesia in Obstetrics LOUIS H DOUGLASS, M D , Baltimore, Presiding  
Collaborators FREDERIC SCHREIBER, M D , Detroit, PAUL TITUS, M D , Pittsburgh, RALPH M TOVELL,  
M D , Hartford

Non-malignant Diseases of the Intestines THOMAS E JONES, M D , Cleveland, Presiding  
Collaborators IRVIN ABELL, M D , Louisville, CHARLES W MAYO, M D , Rochester, Minn , J L  
McGEHEE, M D , Memphis

Colles' Fracture PAUL B MAGNUSON, M D , Chicago, Presiding  
Collaborators ROBERT H KENNEDY, M D , New York, ROBERT D SCHROCK, M D , Omaha, GEORGE D  
WILSON, M D , Toronto

Suppurative Conditions of the Lung NORMAN S SHENSTONE, M D , Toronto, Presiding  
Collaborators WILLIAM A HUDSON, M D , Detroit, WILLIAM F RIENHOFF, JR , M D , Baltimore, PAUL  
C SAMSON, M D , Oakland, Calif

Management of Gangrene in Diabetics ARTHUR A ZIEROLD, M D , Minneapolis, Presiding  
Collaborators WALTER H NADLER, M D , Chicago, JOSEPH B PRIESTLEY, M D , Des Moines, BEVERLY  
CHEW SMITH, M D , New York

## ASSEMBLY OF INITIATES

*Monday, 3 00 p m , Auditorium, American College of Surgeons, 40 East Erie St*

Processional—Initiates, Officers, Regents, and Governors  
Opening Remarks GEORGE P MULLER, M D Philadelphia, President  
The Program of the American College of Surgeons  
ARTHUR W ALLEN, M D , Boston, Vice Chairman, Board of Regents  
BOWMAN C CROWELL, M D , Associate Director  
MALCOLM T MACLACHERY, M D , Chicago, Associate Director  
The Fellowship Pledge Recital by Initiates  
Greetings to the Initiates EVARTS A GRAHAM, M D , St Louis, President-elect  
Closing Remarks IRVIN ABELL, M D , Chairman, Board of Regents  
Signing of the Fellowship Roll The Initiates  
Reception by the officers and regents for the fellows and initiates and members of their families



## ANNUAL HOSPITAL STANDARDIZATION CONFERENCE

*Monday 10:00 a.m.—Ballroom, Stevens Hotel*

- GEORGE P. MILLER, M.D. Philadelphia, President, American College of Surgeons, presiding.  
 Address of the President—The Hospital Program of the American College of Surgeons.  
 Report of the 1940 Hospital Standardization Survey—Official Announcement of the List of Approved Hospitals. JAMES ARELL, M.D. Louisville—Chairman, Board of Regents, American College of Surgeons.  
 Report on Graduate Training in Surgery. DALLAS B. FROSTBERG, M.D. Chicago.  
 The Hospital of Tomorrow. RAY A. M. SCHWITZALLA, S.J. St. Louis. President, Catholic Hospital Association.  
 Medical Preparation for National Emergency. ROSE T. McLESTAY, M.D. Washington, Surgeon-General, United States Army.  
 Preparation for National Emergency from the Standpoint of the Hospital. E. W. JONES, Albany, N. Y.  
 The Effect of the Present Trend in Specialization in Medicine on Hospital Administration and Service. BENJAMIN W. BLACK, M.D. Oakland, Calif. President, American Hospital Association.

*Monday 10:30 a.m.—Ballroom, Stevens Hotel*

- HARRY E. MOCK, M.D. Chicago, presiding.  
 Convalescent Care—The Missing Link in the Care of Many Patients. HARRY E. MOCK, M.D. Chicago.  
 Socio-Economic Aspects of Convalescent Care. ELIZABETH G. GARNETT, New York.  
 Minimum Standards for Convalescent Hospitals. E. H. L. CONWAY, Ph.D. New York.  
 Essentials in Planning of Institutions for Convalescent Care. WILLIAM H. WALTON, M.D. Chicago.  
 Institutional Convalescent Care for Various Types of Patients.  
 The Surgical Patient. W. EDWARD GALLIE, M.D. Toronto.  
 The Medical Patient. NEWELL C. GILBERT, M.D. Chicago.  
 The Cancer Patient. FAYE E. ADLER, M.D. New York.  
 The Fracture Patient. ROBERT H. KROONCE, M.D. New York.  
 General discussion. Opened by KARL A. MEYER, M.D. Chicago, JOHN S. COLEMAN, M.D. Chicago, JOSEPH KIRBY, Chicago.

*Monday 4:30 p.m.—Lobby and Floor, Stevens Hotel*

Consultation Service

*Tuesday 7:45 a.m.—Private Dining Room, Stevens Hotel*

- Breakfast Conference, Sponsored by the American College of Hospital Administrators in co-operation with the American College of Surgeons. The Hospital Administrators' Program for Self Development. VERNER C. BACHMAYER, M.D. Chicago, presiding.  
 Discussion from the following aspects:  
 Institutions for Hospital Administrators. BENJAMIN W. BLACK, M.D. Oakland, Calif.  
 Apprenticeship Training. CLAUDE W. MICHENER, M.D. New York.

Self Study and Personal Development. JOSEPH S. NOBLE, M.D. Chicago.  
 General discussion. Opened by FLORENCE KING, St. Louis.

*Tuesday 9:30 a.m.—Upper Tower Ballroom, Stevens Hotel*

- OCT M. HANVICK, Colorado Springs, Colo. presiding.  
 Greetings from the American Protestant Hospital Association. OCT M. H. HANVICK, Colorado Springs.  
 Panel Discussions  
 Qualifications for Performing Major Surgery. Conducted by HANCOCK L. FOW, M.D. Duynville, Pa.  
 Discussion by CLARENCE E. REEVE, M.D. San Diego, Calif.  
 The Respective Roles of the Professional and Administrative Staffs in the Control of Postoperative Infections. Conducted by FRANK L. MILLER, M.D., New York.  
 Operating Room Supervisor. MARGARET E. SCHAPIRA, Ann Arbor, Mich.  
 Anesthesia Hazards. Conducted by JOHN S. LEXER, M.D. Rochester, Minn.  
 Physical Hazards—Explosibility and Inflammability. RAUL M. TOWELL, M.D. Hartford.  
 Anesthesia Hazards—The Administration of Anesthesia by Inexperienced Persons. HENRY S. R. TH, M.D. Merion, Pa.

*Tuesday 10:00 a.m.—Upper Tower Ballroom, Stevens Hotel*

- Conference on Nursing Service and Nursing Education.  
 VERNER C. BACHMAYER, R.N. Chicago, presiding.  
 Essentials of Good Nursing Care of the Patient. SEYMOUR M. BRUNNER, R.N. Milwaukee.  
 Panel Discussions  
 Administrative Costs of Nursing Based on Recent Study and Published Report. Conducted by CLAUDE W. MICHENER, M.D. New York.  
 Discussion from the viewpoints of:  
 Special Problems in the Repatriation of Nursing Education and Nursing Costs. CHARLES A. ROVETTA, Chicago.  
 The Responsibility and Contribution of the Nursing Administrator in Nursing Cost Study. BLANCHETTE FRYER, R.N., New York.  
 Accounting in Nursing Costs. C. RUTH ROBERT, Ph.D. Chicago.  
 General Discussion.  
 The General Plan for Accrediting Schools of Nursing. Conducted by ELIZABETH C. B. MOORE, R.N. New York.  
 Discussion from the viewpoints of:  
 Consultant to Committee on Accrediting, National League of Nursing Education. GEORGE A. WOLFE, Chicago.  
 Hospital Administrator. ROBIN C. BLANK, M.D. Madison.  
 Nursing Administrator. MARGARET CARBINGTON, R.N. Chicago.  
 General Discussion.

*Tuesday 4:30 p.m.—Lobby and Floor, Stevens Hotel*  
 Consultation Service.

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*Tuesday, 7 30 p m —Upper Tower Ballroom, Stevens Hotel*

Panel Round Table Conference Organization, Management, and Special Problems of the Small Hospital A F BRANTON, M D, Willmar, Minn, presiding  
Personnel—Securing and Maintaining Competent Administrative and Other Personnel MARJORIE M IBSEN, R N, Highland Park, Ill  
Medical Staff—Organizing and Functioning of the Medical Staff F JANE GRAVES, R N, Alton, Ill  
Adjunct Services—Providing Adequate Laboratory, X-ray, and Other Essential Services for the Treatment of the Patient I P McNAMARA, M D, Dubuque, Iowa

Medical Records—Securing Good Medical Records AL PHONUS M MCCARTHY, M D, Electric Mills, Miss  
Nursing—Providing Efficient Nursing Service MABEL L KUEBLER, R N, Louisville  
Financing—Meeting the Problem of Finance JI WELL W THRASHER, R N, Dothan, Ala  
The Women's Auxiliary—Organization, Management, and Special Problems ANNE F GOODYEAR, Hastings, Mich  
Public Relations—Promoting a Public Relations Program CHARLOTTE GARRISON, R N, Battle Creek, Mich  
Hospital Standardization—Meeting the Requirements for Approval by the American College of Surgeons E W WILLIAMSON M D, Chicago  
Collaborators GRAHAM L DAVIS, Battle Creek, Mich, PAUL H FESLER, Nopeming, Minn

*Wednesday, 7 45 a m —Private Dining Room, Stevens Hotel*

Breakfast Conference, Sponsored by the American Association of Medical Record Librarians in co operation with the American College of Surgeons The Medical Records Librarians' Program for Self Development  
Discussion from the following aspects  
Approved Courses for Medical Records Librarians ALICE G KIRKLAND Oakland, Calif  
Need for Courses for Medical Records Librarians Already in the Field EDNA K HUFFMAN, Chicago  
Self Study and Personal Development MARGARET F HOOVER, Pittsburgh  
General Discussion

*Wednesday, 9 30 a m —Upper Tower Ballroom, Stevens Hotel*

Joint Conference with American Association of Medical Record Librarians ROBIN C BUERKI, M D, Madison, presiding  
Greetings from the American College of Surgeons to the American Association of Medical Record Librarians MALCOLM T MACEachern, M D, Chicago  
Personal, Professional, and Other Qualifications of a Successful Medical Records Librarian DOROTHEA M TROTTER, R R L, Grand Rapids, Mich  
The Adoption and Putting Into Operation of the Standard Medical Nomenclature EDWIN P JORDAN, M D, Chicago  
Surgical Nomenclature HILGER P JENKINS, M D, Chicago  
The Practical Application of the Punch Card System in Assembling Statistical and Research Data from the Medical Records JESSIE L HARNED, R R L, Durham, N C  
Guiding Principles of the Medical Records Librarian in Her Relations with the Resident Staff SISTER MARY SERVATIA, R R L, St. Louis

Open Forum Discussion Problems Pertaining to the Obtaining of Good Medical Records Conducted by ROBIN C BUERKI, M D, Madison, Wis

*Wednesday, 12 00 m —Lobby, 3rd Floor, Stevens Hotel*

Consultation Service

*Wednesday, 2 30 p m —Local Hospitals*

Group Conferences and Demonstrations  
Augustana Hospital E I ERICSON, Superintendent  
Central Service for Surgical Dressings AGNES HANSON, R N  
Rehabilitation and Modernization of the X ray Department DAVID S BFILIN, M D  
Management of the Pharmacy Service FRANCES DOUGLAS, Ph G  
Children's Memorial Hospital MABEL W BINNFR, R N, Superintendent  
Outpatient Clinic Management, Inspection of New Clinic Building BABETTE S JENNINGS  
Organization and Management of Laundry and Linen Service ALOIS J ULRICH  
Purchasing and Stores CARRIE H JONES  
Cook County Hospital GENERAL MANUS McCLOSKEY, Warden  
Central Control of Parenteral Solutions FREDERICK STEIGMAN, M D  
Preservation and Use of Medical Records in a Large Hospital STELLA FORD WALKER  
Organization and Management of a Blood Bank Service ELIZABETH SCHIRMER, M D  
Grant Hospital CLINTON F SMITH, Administrator  
Central Stores, Perpetual Inventory, Purchasing ROLAND A SCOTT  
Central Service MARGARET KARSTEN MIHULA  
Medical Records Librarians' School EDNA K HUFFMAN  
Department of Nursing Conference Featuring Ward Instruction and Ward Supervision ELIZABETH C WIVEL, R N  
Henrotin Hospital VERONICA MILLER, R N, Administrator  
Office Management HENRIETTA DRAGER  
Central Control of Supplies MILDRED KRAUSE, R N  
Housekeeping MILDRED PAGE  
Michael Reese Hospital ALBERT H SCHMIDT Associate Director  
Personnel Management GEORGE PECK  
Clinic Management and Medical Social Service ELIZABETH McCONNELL and LEONORA RUBINOW  
Modern Laundry Methods R J GABRIELSON  
Presbyterian Hospital ASA S BACON Superintendent  
Personality in the hospital—the Front Office—Contact and Dealing with Patients, Relatives, and Friends ASA S BACON  
Business Methods—Accounting, Purchasing, Income, Charges, Control HERMAN HENSFL and LESLIE D REID  
Centralized Food Service BEULAH HUNZICKER  
St Joseph Hospital SISTER ZITA, A M Administrator  
Organization and Management of the Obstetrical Department Rehabilitation of the Physical Plant CLYDE GEIGER, M D, and EMILY MARCOULIER  
Operating Room Management, Technique and Procedures, Rehabilitation of the Physical Plant SISTER DELPHINE, R N, B S  
Food Administration SISTER RUFINA R N, B S  
University of Chicago Clinics G OTIS WHITECOTTON, M D, Superintendent

Anesthesia Operating Room Management and Technique H. W. LIVINGSTON, M.D. and DOUGLAS SCHMIDT, R.N.

Food Service ELLA M. ECK  
Medical Records Library Creation of Medical Record ADRIAN HAYDEN

Women and Children Hospital EDW. H. NELSON, Superintendent

Mother's Milk Bureau MARION GREENE

Care of Newborns MARIE HARRIS

Obstetrical Technique and Procedures DR. THOMAS E. TUCKER, M.D.

### Wednesday 7:30 p.m.—Upper Tower Ballroom Stevens Hotel

Departmental Panel Round Table Conference Conducted by ROBERT C. BECKWITH, M.D., Madison, Wis. and MICHAEL T. MACFARLANE, M.D., Chicago.

Administrative Practices THOMAS T. MCFARLANE, Albany  
Anesthesia Service HENRY A. CONNOR, M.D., Milwaukee

Patients' Libraries SELMA LITVINSKY, Chicago

Business Management WILLIAM J. GRIFFIN, Detroit

Food Service HENRY MARSH, Chicago

Laundry and Linen Service ALICE J. LARSON, Chicago  
Medical Records MARGARET C. TAYLOR, Rochester, N.Y.

Medical Social Service JOSEPH G. TILSON, Chicago

Medical Staff CHARLES B. PETERSON, M.D., Chicago

Nursing Service ELIZABETH ODELL, Evanston, Ill.

Obstetrical Service CARL P. HEWITT, M.D., Indianapolis

Outpatient Department ALMA V. UZZEY, Milwaukee

Pathological Service LALL G. MONTGOMERY, M.D., Monroe, Ind.

Physical Therapy JOHN S. COCHLEY, M.D., Chicago

T. berodosis M. POLLAK, M.D., Peoria, Ill.

Ultraviolet Oscar E. OLSON, Madison, Wis.

X-ray Service JAMES T. CASE, M.D., Chicago

### Thursday 7:45 a.m.—Private Dining Room Stevens Hotel

Breakfast Conference The Public Relations Program of Your Hospital ALICE B. MILLER, Chicago, presiding  
Discussions from the following aspects:

Newspaper Publicity LAUREN JACKSON, Chicago

Annual Reports A. S. BACON, Chicago

Syndicated Material ALBERT C. HANKE, E. Evanston, Ind.

Fund Raising ADRIAN MCCUTCHEN, R.N., Evanston, Ill.

General Discussions Opened by CARL L. FLAHERTY, Detroit.

### Thursday 8:30 a.m.—Upper Tower Ballroom Stevens Hotel

Panel Discussion on Hospital Problems of Current Interest to the Hospital F. MAX W. BRADLEY, M.D., St. Louis, presiding

Hospital Administration and Its Relation to Organized Medicine BOWEN FREUDENBERG, Brooklyn

The Problem of T. berodosis in the General Hospital EUGENE S. MARSH, M.D., Oak Terrace, Minn.

An Organized Health Service for Hospital Employees ROBERT E. NEFF, Iowa City, Iowa

The Implications of Good Medical Staff Organization JOSEPH G. TILSON, Milwaukee

Hospital Rates ALBERT H. SCHMIDT, Chicago

Thursday 10:30 a.m.—Lobby 3rd Floor Stevens Hotel

Consultation Service

### Thursday 2:30 p.m.—Local Hospitals

Group Conferences and Demonstrations

Chicago Lying In Hospital and Dispensary S. A. TUCKER, Assistant to Director

Registration and Admission JEA. B. A. DEWITT

Isolation of Obstetrical Patients G. OWEN H. KELL, R.N.

Nursery Management GEORGE H. KELL, R.N.

Mount Sinai Hospital STEPHEN M. WEINSTEIN, M.D.

Director

Medical Staff Organization and Administration Central

STEFAN M. WEINSTEIN, M.D.

Clinical Laboratory—Organization, Management and

Service I. D. WEINSTEIN, M.D.

Business Management—Accounting, Purchasing and

Revenue NATALIE W. HELLMAN, C.P.A.

Presbyterian Memorial Hospital IRVING S. CUTLER, M.D.

Superintendent

Oxygen Therapy M. HERBERT BARKER, M.D.

Physical Therapy JOHN S. COCHLEY, M.D.

Engineering and Maintenance Problems WILLIAM M.

D. TUCKER

Raymond Hospital J. DEWEY LUTER, Administrative

General Administration of 300 Bed Hospital J.

DEWEY LUTER

Medical Records Department HELENA BRYNER

Medical Library LARSON, PEERY

Research and Educational Hospitals M. JON H. WORT-

INGTON, M.D., Managing Officer

Psychiatry in General Hospital, Inspection of New

Neuro-Psychiatric Building J. R. SCHMIDT, M.D.

Central Supply Service and Central Linen Exchange

AND LUTHER LARSON

Study Tour of Orthopedic Hospital VICTOR LUTER J.

RAVENS, R.N., Assistant Chief Nurse

St. Elizabeth Hospital STEPHEN M. WEINSTEIN, R.N.

Superintendent

Obstetrical Department in General Hospital J. R.

LUTER, M.D.

Central Supply Service STEPHEN M. WEINSTEIN, R.N.

Modernized Nursery Techniques MARIE DALTON, R.N.

St. Luke's Hospital CHARLES A. WOODHEAD, Director

Business Methods—Accounting, Purchasing, Stores,

Preparation of Budget Monthly Reports F. MAX W.

TUCKER

Equipment and Procedures for Dressing Cast, Modified

Wassermann, or Gravity Section FREDERICK W.

STEWART

Set Up in Major Operating Rooms with Special Refer-

ence to Personnel, Blood Transfusions MARIE DALTON, R.N.

Wesley Memorial Hospital E. R. STEWART, Superintendent

Practical Problems in Anesthesia and Oxygen Therapy

MARY KARP, M.D.

Food Service ELIZABETH H. TUCKER

Procedures in the Obstetrical Department VICTOR J.

JOHNSON

West Suburban Hospital L. C. VONDER HAYD, Superin-

tendent

Management of the Newborn Humidity Deodorsant

Nursery Safeguard LUCY H. SCHMIDT, R.N. MARY

MOLLOY, R.N. and L. C. VONDER HAYD

Patient Identification OLIVER P. POWELL, M.D.

Maintenance of the Physical Plant and Engineering

D. W. PATTERSON

Woodlawn Hospital G. MAX L. D. VILLERS, R.N., Super-

intendent

A Study of Organization, Management and Procedures

in Private Hospital of 300 Beds GRACE L. DUNN,

STEWART, R.N. and Staff.

# PRELIMINARY CLINICAL PROGRAM

ARRANGED IN THE FOLLOWING SUBDIVISIONS GENERAL SURGERY, OBSTETRICS AND GYNECOLOGY, GENITO-URINARY SURGERY, FRACTURES AND OTHER TRAUMAS, ORTHOPEDIC SURGERY, THORACIC SURGERY, NEUROSURGERY, OPHTHALMOLOGY, OTOLARYNGOLOGY

## GENERAL SURGERY

### Monday

#### CHICAGO MEMORIAL HOSPITAL

PETER S CLARK, CHARLES J DRUECK, ROBERT A MELENDY, BENNETT R. PARKER, JOHN VAN PROHASKA, M L WEINSTEIN, LEO M ZIMMERMAN, and GEORGE M LANDAU—1 Operative and dry clinic  
JOHN VAN PROHASKA Surgical aspects of carcinoma of ampulla of Vater, enterogenous cysts in infants  
M L WEINSTEIN Resection of stomach with DePetz instrument, rectal anesthesia  
LEO M ZIMMERMAN Essential problems in the surgical treatment of inguinal hernia.  
BENNETT R PARKER. Problems in gall bladder surgery

#### COOK COUNTY HOSPITAL

Staff—2 Symposium on biliary tract disease  
EDMOND F FOLEY Medical aspects  
HANS L POPPER Perverted physiology  
FREDERICK STEIGMAN Jaundice  
HARRY CULVER Urological factors in differential diagnosis  
WALTER SCHILLER Pathology  
M J HUBENY Roentgenological aspects in diagnosis  
LINDON SEED Clinical results with synthetic Vitamin K in jaundice.  
RAYMOND W MCNEALY Pre and postoperative management  
KARL A MEYER. Operative management.  
MARSHALL DAVISON Post-cholecystectomy pain

#### Scientific Exhibit

Presented by following departments Pathology, roentgenology, neurosurgery, blood bank, solutions laboratory, medical record library, therapeutics, and the Cook County Graduate School of Medicine.

#### MICHAEL REESE HOSPITAL

Staff—2 Symposium on transfusion and infusion  
LEO M ZIMMERMAN History of blood transfusion  
SIDNEY O LEVINSON General survey of a modern transfusion department.  
HAROLD LAUFMAN Blood transfusion reactions, statistical study  
ANNA MARIE STRAUSS Experiences with indirect transfusion reactions  
H NECHELES Plasma and serum as substitutes for whole blood transfusions, physiology and laboratory experiments  
FRANK RUBOVITS Clinical experience with plasma and serum transfusions  
Inspection of transfusion and serum departments

#### RESEARCH AND EDUCATIONAL HOSPITALS

#### Scientific Exhibit

Cancer of the large bowel and appendicitis

### Tuesday

#### AUGUSTANA HOSPITAL

NELSON M PERCY and OSCAR E NADEAU—9 Operative and dry clinics

#### ALBERT MERRITT BILLINGS HOSPITAL

L R DRAGSTEDT and HILGER P JENKINS—9 Operative and dry clinic

#### COOK COUNTY HOSPITAL

KARL A MEYER—9 Operative clinic Stomach and colon  
JOHN R HARGER—9 Operative clinic Peridural anesthesia for major operations  
C C GUY—9 Dry clinic Surgical problems in the diabetic  
SUMNER L KOCH—9 Dry clinic Injuries and infections of the hand  
RAYMOND W MCNEALY—10 Operative clinic Gall-bladder, gastric surgery  
E M MILLER—10 Dry clinic Bowel obstruction in the newborn, gangrene complicating scarlet fever, volvulus of sigmoid colon in children  
J D KOUCKY—10 Operative and dry clinic Arteriosclerotic gangrene of the legs  
JOHN B O'DONOGHUE—10 Operative clinic Gastrointestinal  
Staff—2 Symposium on military organization in the care of wounded under war conditions

#### Scientific Exhibit

Presented by following departments Pathology, roentgenology, neurosurgery, blood bank, solutions laboratory, medical record library, therapeutics, and the Cook County Graduate School of Medicine.

#### COOK COUNTY GRADUATE SCHOOL OF MEDICINE

Staff—1 Demonstration on cadaver, some principles in gall bladder surgery

#### EVANGELICAL HOSPITAL

P E HOPKINS, G E JOHNSON, and JAMES PATEJDL—9 Operations

#### EVANSTON HOSPITAL

W R PARKES, FREDERICK CHRISTOPHER, W KENNETH JENNINGS, J PEERMAN NESSELROD, JAMES P GRIER, J E KEARNS, and FREDERICK WILLIAM MERRIFIELD—9 Operative and dry clinic  
FREDERICK CHRISTOPHER Abdomino perineal resection for carcinoma of the rectum  
W KENNETH JENNINGS The colostomy  
JAMES P GRIER Surgery of the biliary tract  
J E KEARNS Vascular clinic  
J PEERMAN NESSELROD Motion pictures of the rectum  
FREDERICK W MERRIFIELD Oral surgery

## GRANT HOSPITAL

KARL A. M. ITT — Operations.  
A. G. ZIMMERMAN — Operations

## MICHAEL REESE HOSPITAL

Staff—9 Operative clinic  
JAMES P. REESE, Gastro-intestinal.  
R. B. BETTMAN and WILLIAM T. KENNEDY, Gall-bladder.  
A. A. STRAUSS and S. F. STRAUSS, Stomach and colon.  
S. L. GOLDBERG, General.  
Staff—9 Dry clinic: Symposium on peptic ulcer  
H. NICKELLEN, Newer conceptions of the physiology of stomach in relation to ulcer  
JACOB MEYER, The bleeding ulcer  
H. F. BROWN, Treatment of bleeding ulcer with colloidal preparations  
S. F. STRAUSS, Indications for gastric surgery  
A. A. STRAUSS, Subtotal gastric resection.  
JAMES P. REESE, New methods in gastric surgery  
Staff—1, Dry clinic  
LEO M. ZIMMERMAN, Anatomy of inguinal hernia in relation to surgery  
N. TH. VAN CAPOVE, Incidence of strangulation in inguinal hernia: treatment of hernia  
LEO M. ZIMMERMAN and H. LALOR, Urological complications of inguinal hernia  
R. B. BETTMAN and WILLIAM T. KENNEDY, Wound eversion  
S. L. GOLDBERG, Septicemia  
D. C. STEIN, Epiphyseal separations.  
Staff—1 Dry clinic: Peripheral vascular surgery.  
LEO M. ZIMMERMAN and S. MICHOVITS, Thrombo-phlebitis and pulmonary embolism.  
H. A. RYAN, Indications and technique of suprapubic cleft fixation  
S. MILES PERLOW and S. S. HALPERN, Protrusion in peripheral vascular disease.  
S. MILES PERLOW, Injection treatment of angina pectoris: sympathectomy for peripheral vascular disturbances  
S. AGNEW and E. BIRNBAUM, Treatment of aneurysms in the aged.  
S. MILES PERLOW and E. BIRNBAUM, Ligation of the lower suprapubic cleft.

## RAVENSWOOD HOSPITAL

Staff—9 Operations  
Staff—1 Tumor clinic: Scientific exhibit: demonstration of procedure  
Staff—1 Last results of aneurysm operations.

## RESEARCH AND EDUCATIONAL HOSPITALS

GEORGE DE TAKATS, J. T. REYNOLDS and Staff—9 Operative clinic and symposium on hypertension. Splanchic nerve section for hypertension  
S. R. ROSENTHAL, Renal biopsies.  
F. K. HAY, Physiology of the heart in hypertension  
H. C. LATHAM, The kidney function in hypertensive states  
H. E. HAYES, The brain in hypertensive states  
R. O. RIEBER, The eye grounds in hypertension—Illustrated by kiodachrome slides.  
GEORGE DE TAKATS and associates, The surgical approach to the problems of hypertension.

## Scientific Exhibit

Cancer of the large bowel and appendix

## ST JOSEPH HOSPITAL

Staff—9 Operative and dry clinics  
HELEN McKINNEY, Cholecystectomy; thyroidectomy; closure of colon following second stage malar operation for carcinoma of descending colon  
WILLIAM BAKER, Acute intestinal obstruction  
BERT FITZGERALD, Thyroidectomy  
LEONARD KATZ, Ruptured appendix  
FRANK MCCARTY, Thyroidectomy; cholecystectomy; stomach surgery; gall-bladder disease.  
J. A. WOODHEAD, Thyroidectomy  
STURGEON A. ZEHL, Herniotomy; moving pictures of hernia operation.

## ST LUKE'S HOSPITAL

W. R. CULLEN—9 Operations.  
SHELL W. McARTHUR—9 Operations  
Staff—9 Dry clinic:  
E. C. HOLMES and R. A. JACOBSON, Treatment of gas gangrene.  
T. L. HAYES and J. M. L. JENSEN, Shell fractures of ribs.  
JOHN D. ELLIS, Amputations.  
JOHN L. LINDGREN, Physiological problems and management in postoperative gastro-intestinal constant suction drainage.  
C. A. PONTRE, Hypertrophic pyloric stenosis in the adult  
H. I. MILES, Paget disease osteomyelitis  
W. R. CULLEN, Combined abdominal and chest injuries with differential diagnosis  
LEO GOLDBERG, Spinal injuries.  
ALVIN P. SCHWARTZ, Personality disorders during readjustment following personal and industrial injuries.  
H. E. MILES and associates—9 Shell fracture exhibit.  
PAUL W. GREENE—9 Operations: Total reconstruction of external ear rhinoplasty.

## WESLEY MEMORIAL HOSPITAL

R. VANCE W. M. ALLEN—9 Thyroidectomy; resection of colon  
S. J. FOWLER—9 Gastric resection  
WILLIAM M. McFARLANE—9 Repair of inguinal hernia.  
JOSEPH I. SCHWARTZ and KENNETH W. FERRALL—9 Repair of cleft palate  
WILLIAM A. HANCOCK—9 Demonstrations: Lymphoma; cancer of the stomach; stab wound of the heart with repair; isolated simple non-specific ulcer of the rectum, healing without surgery  
C. S. V. MAYER—9 Demonstration: Cecocolic duct stone; rib fracture of common duct  
EARL O. L. TORRE—9 Gastric resection  
WILLIAM MILES—9 Cholecystectomy  
VORON G. PARR—9 Cholecystectomy

## MUNICIPAL TUBERCULOSIS SANITARIUM

CARLTON L. MARTIN—9 Aneurysmal tuberculosis

## W. Colwell

## AUGUSTANA HOSPITAL

A. T. LUNDGREN and EARL GARRETT—9 Operative and dry clinic  
JOHN W. NEUMANN and R. DOUGLAS COOK—9 Operative and dry clinic

## CHICAGO MEMORIAL HOSPITAL

Medical, surgical, ray and pathological departments—Symposium: Treatment of pneumonia with serum and salicylpyridine; peptic ulcer

CHILDREN'S MEMORIAL HOSPITAL

ALBERT H MONTGOMERY, JOHN A GRAHAM, JAY IRELAND,  
W J POTTS, J J MUSSIL, A E DIGGS, and S E  
LAWTON—9 Operations

COOK COUNTY HOSPITAL

VICTOR L SCHRAGER—9 Operations  
RALPH C SULLIVAN—9 Operations  
EDWARD A CHRISTOFFERSON—9 Operative clinic Ap-  
pendicitis  
FRANK J JIRKA—10 Dry clinic Dysgerminoma in the  
male  
J R. BUCHBINDER—1 Operative clinic Thyroid, biliary  
tract.

Scientific Exhibit

Presented by following departments Pathology, roentgen-  
ology, neurosurgery, blood bank, solutions laboratory,  
medical record library, therapeutics, and the Cook  
County Graduate School of Medicine

COOK COUNTY GRADUATE SCHOOL OF MEDICINE

Staff—1 Demonstrations on cadaver and anesthetized  
dog Gastric surgery

HENROTIN HOSPITAL

ROBERT T SHARER—9 Operative and dry clinic Gastro-  
jejunal ulcers

JACKSON PARK HOSPITAL

C C CLARK—9 Abdominal operations  
A BAMBERGER—10 Abdominal and thyroid operations  
H H COX—10 Operative and dry clinic

LORETTO HOSPITAL

C PERRY VAUGHN—9 Operations.  
ALLEN E STEWART and L NEWMAN—10 Operative and  
dry clinic.  
FRANK M SYLVESTER—10 Operations  
LOUIS F PLZAK and FRANK F KOTALIK—10 Goiter clinic.

MERCY HOSPITAL

M F McGUIRE—9 Operative and dry clinic Biliary  
tract.  
WILLIAM J PICKETT—9 Operative and dry clinic Gas-  
tric surgery  
C F SAWYER—9 Intestinal obstruction  
J SANDROY—9 Tests for liver function

MICHAEL REESE HOSPITAL

Staff—9 Operative clinic  
M L PARKER Thyroid  
A. A STRAUSS and S F STRAUSS Gastro intestinal  
R. B BETTMAN and WILLIAM TANNENBAUM Surgery of  
extra hepatic bile tracts  
NATHAN N CROHN Subject to be announced  
LEO M ZIMMERMAN Hernia  
Staff—9 Dry clinic Symposium on diseases of the bile  
tracts  
H. NECHELES New knowledge of physiology of the  
gall bladder  
S PORTIS Medical indications for surgery of the gall  
bladder  
A M SERBY Liver function tests  
R B BETTMAN Technique of gall bladder operations  
with motion pictures  
WILLIAM TANNENBAUM. Carcinoma of the gall bladder  
G M LICHTENSTEIN End results of gall bladder surgery  
NATHAN N CROHN Measurements of the common and  
cystic ducts  
ROBERT ARENS and R. B BETTMAN Immediate chol-  
angiography

Staff—2 Dry clinic

LEON BLOCH Ulcerative colitis  
A A STRAUSS Indications for ileostomy in colon  
surgery  
S F STRAUSS Surgical lesions of the colon  
ROBERT ARENS X ray diagnosis of diseases of the  
colon  
OTTO SAPHIR Pathology of the colon  
H NECHELES Newer physiology of the intestines

MOTHER CABRINI MEMORIAL HOSPITAL

E J CHESROW and associates—9 Abdominal operations

PASSAVANT MEMORIAL HOSPITAL

SUMNER L KOCH, MICHAEL L MASON, and HARVEY ALLEN  
—9 Dry clinic Presentation of cases illustrating prob-  
lems in surgery of the hand, discussion of wound in-  
fections

RESEARCH AND EDUCATIONAL HOSPITALS

WARREN H COLE and staff—9 Operative clinic and thy-  
roid symposium Thyroidectomy, prerequisites for  
thyroidectomy  
R B MALCOLM Surgical pathology of goiter  
J T REYNOLDS Postoperative treatment  
CHARLES B PUESTOW Suture material and end results  
LINDON SEED King operation for recurrent nerve  
paralysis  
R W KEETON Management of patients with hyper-  
thyroidism and cardiac disease  
P W GREELEY—9 Thick razor graft to axillary con-  
tracture, island artery flap to nose, costal cartilage  
graft to nose, full thickness skin graft to hand, demon-  
stration of finished plastic cases  
P J SARMA—9 30 Varicose vein clinic  
WARREN H COLE—11 15 Splenectomy

Scientific Exhibit

Cancer of the large bowel and appendicitis

ST ANNE'S HOSPITAL

G F THOMPSON, J J GEARIN, J L KNAPP, J W KEANE,  
ADOLPH KRAFT, and H M PETERSON—9 Operations  
ADOLPH KRAFT—1 Dry clinic Carcinoma of cecum  
G F THOMPSON—1 Dry clinic Carcinoma of breast,  
blastomycosis of cecum

ST BERNARD'S HOSPITAL

WILLIAM G EPSTEIN—9 Thyroid operations  
L B DONKE, G M CUSHING, and WILLIAM MULHOL-  
LAND—9 Abdominal operations  
S L GOVERNALE—9 Dry clinic Pseudohypertrophic mus-  
cular dystrophy

ST LUKE'S HOSPITAL

H E MOCK—9 Operations  
Staff—9 Dry clinic  
SELIM W McARTHUR Stomach deformities simulating  
malignancy in x ray study  
F L McMILLAN Lesions of the colon  
H. E JONES Treatment of complete biliary fistulas  
E LEE STROHL Common duct obstructions  
W G DIFFENBAUGH Autoplastic operation for hernial  
repair, statistical report.  
H E Mock. Breast tumors, malignancies and granu-  
lomas of the gastro-intestinal tract.  
E W RYERSON Conservative treatment of fractures  
T P GRAUER. Injuries of the genito urinary tract  
HAROLD A SOFIELD Fractures of femoral neck.  
H. E Mock and associates—9 Skull fracture exhibit

## SWEDISH COVENANT HOSPITAL

- R. F. ELMER, W. B. STROMBERG, and A. C. PETERSON—*g.*  
Operative clinic: Surgery of stomach and gall tracts.  
K. L. VETZ, A. P. SUNDQUIST, and R. E. TALBOTT—*g.* Head  
and neck infections, anatomical demonstrations.  
M. R. BROMAN—*g.* Problems in pathology in private  
hospital.  
R. G. WILL—*g.* Diagnostic problems studied in private  
hospital.

## VETERANS ADMINISTRATION FACILITY

- F. F. BROWN and B. F. WARD—*g.* Abdominal operations.  
R. B. MCKELVAIN—*g.* Operative clinic: Tumors.  
A. E. WILLIAMS—*g.* Inspection tour of deep x-ray and  
radium unit.  
G. R. ALLANBY—*g.* Dry clinic: Tumor clinic in the general  
hospital, method of presentation of cases before  
Tumor Board, diagnosis, treatment, and follow-up.  
MAX CUTLER—*g.* Dry clinic: Carcinoma of the mouth  
and larynx: problems in diagnosis and treatment. Indica-  
tions for surgery and irradiation in laryngeal carcinoma  
presentation of cases.

## Thursday

## ALEXIAN BROTHERS' HOSPITAL

- WILLIAM J. SWIFT—*g.* Herniotomy.  
DANIEL E. McHERRY—*g.* Circulatory disturbances of lower  
extremity.  
FREDERICK A. REINER—*to.* Abdominal surgery and post  
operative care.

## AUGUSTANA HOSPITAL

- NELSON M. PERRY and OSCAR E. NADZ—*g.* Operative  
and dry clinics. Symposium on diagnosis and surgery of  
gallbladder.

## CHICAGO MEMORIAL HOSPITAL

- CARLES M. ENGLISH—*g.* Operative clinic. Correction of  
cleft palate: facial plastic.

## CHILDREN'S MEMORIAL HOSPITAL

- ALBERT H. MONTGOMERY, J. V. IRELAND, and J. J. MOWSE  
—*g.* Demonstration of cases: Abdominal tumors in  
children: subphrenic abscess, osteomyelitis, retroperito-  
neal tumors.

## COLUMBUS HOSPITAL

- DANIEL A. OXEN—*g.* Operations.  
H. E. D. VAN—*g.* Elective radiation therapy of malig-  
nancies: presentation of cases.  
H. E. KERRY—*g.* Crohn disease: presentation of cases.

## COOK COUNTY HOSPITAL

- RALPH C. SULLIVAN—*g.* Operative clinic.  
MARSHALL D. VERNON—*g.* Operative clinic: Thyroid.  
RALPH B. BIEBER—*g.* Operative clinic.

## Scientific Exhibit

- Presented by following departments: Pathology, roent-  
genology, necropsy, blood bank, solutions laboratory,  
medical record library, therapeutics, and the Cook  
County Graduate School of Medicine.

## COOK COUNTY GRADUATE SCHOOL OF MEDICINE

- RAYMOND W. McNEAL—*g.* Lecture: Femoral hernia.  
Staff—*g.* Demonstration on cadaver: surgery of the  
bowel.

## EVANGELICAL HOSPITAL

- P. E. HOPKINS, G. E. JOHNSON, and JAMES PATRICK—*g.*  
Operations.

## HOLY CROSS HOSPITAL

- V. F. TOWNSEND—*g.* Blood pressure and spinal anesthesia—  
study of 50 cases.

- J. B. KARR—*g.* Injection treatment of hernia, herniotomy.  
F. F. FRANKLIN and N. R. P. VIERTE—*g.* Indirect inguinal  
hernia.  
F. J. SCURTLEY—*g.* Thyroidectomy.  
M. J. BARNETT—*g.* Thyroidectomy.  
J. F. RUDIG and D. S. DICICCO—*g.* Hernioplasty: vaginal hysterectomy, cholecystectomy: common duct exploration  
thyroidectomy.

## ILLINOIS MASONIC HOSPITAL

- WILHELM E. KESSEY and J. WALLER JOHNSON—*g.* Chole-  
cystectomy.  
R. BRUCE MALCOLM—*g.* Partial gastrectomy.  
JOHN R. HANCOCK and JOHN PIERCE—*g.* Cholecyst  
duodenostomy.  
C. DREYER, SR. and HENRY E. OLIVER—*g.* New  
rhinoplasty.  
W. C. BORNHEIMER and J. KROHN—*g.* Herniotomy.  
T. G. WALLIN and B. ULAN WALLIN—*g.* Aspiration of  
breast.  
WARREN PUGH—*g.* Resection of colon.  
JOHN F. D. VAN and A. E. WUNDERLICH—*g.* Colonostomy.  
P. OL MOBY and EDWARD LEVINSKY—*g.* Appendectomy.  
W. B. GERRARD and GEORGE OETTER—*g.* Aspiration  
of breast.

## MERCY HOSPITAL

- L. D. MOOREHEAD—*g.* Operative and dry clinic: Thyroid.  
A. K. VANDER—*g.* Treatment of varicose veins and ulcers.

## MICHAEL REESE HOSPITAL

- Staff—*g.* Operative clinic.  
A. A. STRAUSS and S. F. STRAUSS—*g.* Gastro-intestinal.  
M. L. PARKER—*g.* Subject to be announced.  
JAMES PATRICK—*g.* Stomach and colon.  
S. L. GOLDBERG—*g.* Subject to be announced.  
SAMUEL PHELPS—*g.* Peripheral vascular surgery.  
Staff—*g.* Dry clinic: Thyroid symposium.  
S. SOROKIN—*g.* Physiological disturbances in thyrotoxicosis.  
ROBERT C. LEVY—*g.* Special tests in diagnosis of border-  
line thyroid cases.  
O. SAPIER and LEO M. ZIMMERMAN—*g.* Neoplasms of the  
thyroid.  
M. L. PARKER and H. A. ROSE—*g.* Analysis of 40 years  
thyroid surgery and follow-up.  
A. K. KOFF—*g.* Menstrual disturbances in relation to thy-  
roid disease.  
Staff—*g.* Dry clinic.  
S. L. GOLDBERG—*g.* Fish bone perforation of ileum.  
M. L. PARKER—*g.* Perforating wound of bowel, foreign  
bodies in the stomach, regional ileitis.  
R. B. BIEBER and WILLIAM TANNENBAUM—*g.* Foreign  
body perforation of the intestinal tract: complications  
of gastro-enterostomy.  
S. L. GOLDBERG and L. V. KATZ—*g.* Attempts reducing  
experimental hypertension in dogs.

## MUNICIPAL TUBERCULOSIS SANITARIUM

- RICHARD D. VERNON—*g.* Surgical treatment of tuberculous

## NORWEGIAN AMERICAN HOSPITAL

- J. M. ANDERSON—*g.* Postoperative late acute medi-  
cations.  
G. B. F. DILL—*g.* Surgical physiology of the thyroid.  
A. M. JENSEN—*g.* Subcutaneous in general surgery.  
J. R. GILBERT—*g.* Technique of thyroidectomy.  
F. H. FOWLER—*g.* Tonsillectomy in appendicitis.  
J. V. FOWLER, JR.—*g.* Pre and postoperative care of  
the thyroid patient.

- J E VERHAAG—10 30 Hernia from industrial causes  
 M M CORBETT—10 30 Immediate treatment of abdominal injuries  
 WARREN JOHNSON—11 Carcinoma of the stomach  
 F M NICHOLSON—11 Treatment of scalp injuries  
 M E LICHTENSTEIN—11 30 Technique of cholecystectomy  
 J V FOWLER, SR—11 30 Carcinoma of the breast

## PASSAVANT MEMORIAL HOSPITAL

- JOHN A WOLFER and associates—9 Tumor clinic  
 FRANK QUEEN The surgeon and pathologist as a diagnostic team, i.e., the decision for and conduct of biopsy with illustrative cases  
 EARL E BARTH Important preliminaries prior to x ray therapy  
 H E DAVIS Selection of tumor cases and x ray vs radium therapy  
 HENRY JAFFE Administration of radiation therapy for malignant tumors  
 FRED MERRIFIELD Our results with intra-oral tumors  
 J M GREENE Useful aids in differential diagnosis of tumors of the neck  
 JOHN A WOLFER Our results with cancer of the breast  
 L M SMITH, JR Results with treatment of unusual cutaneous tumors  
 HERMAN CHOR The psychiatrist's part in a tumor clinic, illustrative cases  
 EARL E BARTH Inspection of radiation therapy department of Northwestern University Medical School

## PRESBYTERIAN HOSPITAL

- KELLOGG SPEED, CARL B DAVIS, ALBERT H MONTGOMERY, EDWIN M MILLER, FRANCIS STRAUSS, HARRY OBERHELMAN, W J POTTIS, HILLIER BAKER, FRANK V THEIS, EGBERT H GELL, R K GILCHRIST, and VERNON C DAVID—9 Operations

## RESEARCH AND EDUCATIONAL HOSPITALS

- CHARLES B PUESTOW and staff—9 Operative and dry clinic  
 CHARLES B PUESTOW Cholecystectomy for stone, physiology of the common duct as related to surgery  
 L F FOLFA The jaundiced patient from the medical viewpoint  
 WARREN H COLE Lesions of the cystic duct as related to gall bladder disease  
 LINDON SEED and J KARABIN Use of Vitamin K in hypoprothrombinemia  
 CHARLES B PUESTOW Excision carcinoma of colon

## Scientific Exhibit

Cancer of the large bowel and appendicitis

## ST LUKE'S HOSPITAL

- GÉZA DE TAKATS and J T REYNOLDS—9 Operative clinic  
 Lumbar sympathectomy  
 PAUL W GREELEY—9 Operations Construction of new eyebrows, full thickness skin graft, split skin graft  
 H E Mock and associates—9 Skull fracture exhibit  
 JOHN S COULTER—10 Physical therapy in peripheral vascular disease  
 G K FENN—10 Extracardiac factors influencing coronary circulation  
 G W SCUPHAM—10 Renal disease and hypertension  
 R B CAPPS—11 Vascular reflexes during operations  
 J M L JENSEN—11 Paravertebral block of the sympathetics, technique and indications

- GÉZA DE TAKATS—11 Demonstration in vascular surgery  
 Cervical rib and aneurysm, wired aneurysm of aorta, congenital arteriovenous fistula of the hand, modified Kondoleon operation for thrombophlebitic induration

## ST MARY OF NAZARETH HOSPITAL

- J M LARKOWSKI—9 Operative clinic  
 L H WARSZYSKI—10 Operative clinic  
 THEODORE STEINFERT—10 Operative clinic  
 G M MULLEN—11 Operative clinic

## Friday

## ALBERT MARRIOTT BUILDINGS HOSPITAL

- ALEXANDER BRUNSCHEWIC and WILLIAM F ADAMS—9 Operative and dry clinic

## CHILDREN'S MEMORIAL HOSPITAL

- LOUIS W SCHULTZ—1 Operative clinic and demonstration of cases Oral surgery

## COOK COUNTY HOSPITAL

- LOUIS RIVIER—9 Dry clinic Abdominal incisions  
 L H WARSZYSKI—10 Operative clinic Reconstruction treatment of burns  
 J R BUCHNIBER—1 Operative clinic Gastric resection for duodenal ulcer

## Scientific Exhibit

Presented by following departments Pathology, roentgenology, neurosurgery, blood bank, solutions laboratory, medical record library, therapeutics, and the Cook County Graduate School of Medicine

## MICHAEL REISL HOSPITAL

- JAMES PATRICK, A A STRAUSS, S I STRAUSS, M I PARKER, NATHAN N CROHN, S I GOLDBERG, LEO M ZIMMERMAN, and SAMUEL PERLOW—9 Operations

## MOUNT SINAI HOSPITAL

- D A WILLIS—9 New type of hernioplasty  
 I J CRITTAN—9 Operative clinic  
 V I SCHRAGER and staff—9 Hernioplasty  
 A A STRAUSS and S STRAUSS—9 Surgery of the colon  
 M R GUTTMAN—9 Plastic surgery of the nose  
 JACOB LIFSCHUTZ—9 Endoscopy  
 LEON ALISON—9 Oral surgery  
 J M MORA—9 Thyroidectomy

## PASSAVANT MEMORIAL HOSPITAL

- J R BUCHNIBER—9 Dry clinic Illustrations of end results in treatment of gastric and duodenal lesions

## PRESBYTERIAN HOSPITAL

- IRLDERICK B MOORHEAD—9 Plastic surgery

## RESEARCH AND EDUCATIONAL HOSPITALS

- R B MALCOLM and staff—9 Operative and dry clinic  
 R B MALCOLM Radical resection for carcinoma of breast, surgical pathology of breast tumors, excision of branchial cleft cyst  
 P J SARMA Differential diagnosis of breast lesions  
 T J WACHOWSKI Radiation therapy of carcinoma of breast  
 GEORGE DE TARNOWSKY End results in carcinoma of breast



P. W. GREENE—no. Plastic surgery follow-up clinic  
Scientific Exhibit  
Cancer of the large bowel and appendicitis.

### ST. ELIZABETH'S HOSPITAL

Staff—9. Operative and dry clinics  
A. G. ZIMMERMAN. Thyroidectomy—treatise on pathology of the thyroid gland  
M. G. LUTZ. Hernia operations.  
L. B. KATZELBERG. Surgery of the stomach  
Staff— Operative and dry clinics  
J. B. O'DONOGHUE. Complications in surgery of the gall-bladder and ducts.  
J. P. WOLF LEWIS. Intestinal surgery

### ST. LUKE'S HOSPITAL

H. E. MOORE and associates—9. Skull fracture exhibit

*Do not do need*

### HOSPITAL OF ST. ANTHONY DE PADUA

F. B. OLIVETT and M. J. RADZIMSKOWSKI. Thyroid operations.  
J. J. SPANIEL. Abdominal operations  
S. F. DONOVAN. H. P. SULLIVAN. IRENE E. MAE. W. H. BRADLEY. JOSEPH ZABOZCHKA and R. C. DUFFY. Operative and dry clinic.  
I. V. J. JIRAL. Lecture. Complications under anesthesia

## OBSTETRICS AND GYNECOLOGY

*At end*

### COOK COUNTY HOSPITAL

A. J. KORUC and H. H. HILL—2. Studies in scarification and glycerine.  
JAMES H. BLOOMER—no. Demonstration of cases Cesarean section and local anesthesia, or management of ectopic posterior  
S. J. BENEDICT—2. Cases in the prenatal clinic.  
T. J. MORRIS— Postperforal infection

### RESEARCH AND EDUCATIONAL HOSPITALS

Scientific Exhibit  
Essentials of prenatal care, postperforal sepsis, care of the premature infant, ectopic pregnancies

*Second*

### CHICAGO LYING-IN HOSPITAL

FRED L. ADAMS, WILLIAM J. DIECKMANN, M. EDWARD DAVIS, H. CLOVE HEMSLITZ, and FRANKLIN F. SYDNER—9. Operations  
FRED L. ADAMS and staff— Dry clinic  
FRED L. ADAMS. Subject to be announced  
FREDERICK W. SCHULTZ. Management of birth trauma  
WILLIAM J. DIECKMANN. Treatment of the toxemias of pregnancy  
M. EDWARD DAVIS. Treatment of placenta previa  
GORDON T. BURKE. Treatment of abruptio placentae  
EDITH L. PUTTNER. A review of the post-mortem findings in 2,000 fetal and neonatal deaths  
CHARLOTTE L. CLANCY. Problems in the control of reproduction.

### COOK COUNTY HOSPITAL

W. T. CARLISLE—9. Gynecological operations  
A. E. KARTER— Gynecological operations

### EVANSTON HOSPITAL

W. C. D. VOTER, R. M. GRIER, HOWARD J. HOLLOW, P. H. SMITH, and C. E. GALLOW—9. Operative clinic. Vaginal hysterectomy; abdominal hysterectomy

### MERCY HOSPITAL

HARRIS E. SCHMIDT and staff—9. Operative and dry clinic. Vaginal hysterectomy. Watkins transposition operation. Manchester Forthright operation for uterine plastic. anterior colporrhaphy and perineorrhaphy. La Ferte colporrhaphy  
Staff— Demonstrations and discussions of obstetrical problems.

### MICHAEL REISE HOSPITAL

J. L. BARR—9. Operation. Radical hysterectomy  
J. LACIN—9. Operation. Total abdominal hysterectomy  
L. E. F. KENTON—9. Operation. Cesarean section

### PASSAVANT MEMORIAL HOSPITAL

ARTHUR H. CORTIS and GEORGE H. GARDNER—9. Operative and dry clinic. Integration of newer anatomical studies with clinical gynecology

### RAVENSWOOD HOSPITAL

Staff— Demonstration of cases

### RESEARCH AND EDUCATIONAL HOSPITALS

Scientific Exhibit  
Essentials of prenatal care, postperforal sepsis, care of the premature infant, ectopic pregnancies.

### ST. JOSEPH HOSPITAL

CLYDE GEORGE—9. Operation for carcinoma of the cervix

### ST. MARY OF NAZARETH HOSPITAL

M. E. UHLARSKI—9. Operations  
A. S. SAMPOURSKI— Vaginal hysterectomy

### WELSH MEMORIAL HOSPITAL

MARK T. GOLDSTEIN and associates—9. Operative and dry clinic. Gynecological  
WILLIAM B. SIDDERS—9. Operative and dry clinic. Obstetrical  
GARRETT C. RICHARDSON— Operative and dry clinic. Obstetrical  
CHARLES B. READ— Operative and dry clinic. Obstetrical.

*At end*

### CHICAGO LYING-IN HOSPITAL

FRED L. ADAMS, WILLIAM J. DIECKMANN, M. EDWARD DAVIS, H. CLOVE HEMSLITZ, and FRANKLIN F. SYDNER—9. Operations  
FRED L. ADAMS and staff. Dry clinic  
H. CLOVE HEMSLITZ. The use of sulfanilamide, salicypyridine and sulfathiazole in obstetrics and gynecology  
ROBERT G. BLOCH. Tuberculosis in pregnancy  
FRANKLIN F. SYDNER. Treatment of aplasia neonatorum.  
HENRY T. ZIMMERMAN. Diabetes in pregnancy

SIMON L. WOLTERS Treatment of carcinoma of the uterus  
JOHN H. MORTON Clinical studies in uterine motility  
RUTH WATTS Studies of ovarian tumors

#### CHICAGO MEMORIAL HOSPITAL

HARRY B. W. BENARON, JAMES E. FITZGERALD, WILLIAM F. HEWITT, GEORGE N. SCHIFF, BEATRICE E. TUCKER, and HARRY L. MEYERS—9 Operative and dry clinic  
HARRY B. W. BENARON Presacral block in obstetrics  
GEORGE N. SCHIFF Obstetrical analgesia  
JAMES E. FITZGERALD Effect of Vitamin K in labor  
BEATRICE E. TUCKER and HARRY L. MEYERS Manchester anterior colporrhaphy and perineorrhaphy

#### COOK COUNTY HOSPITAL

HERBERT E. SCHMITZ—9 Gynecological operations  
A. F. LASH—10 Gynecological operations

#### EVANGELICAL HOSPITAL

P. ARTHUR DELANEY and associates Clinical pathological conference, unusual uterine pathology Endometrial sarcoma, malignancy (leiomyosarcoma) in uterine fibroids, sarcoma botryoides, child 2½ years old, adenomyoma uteri (Frankel), endometriosis, actinomycosis in ovaries, granulosa cell tumor of ovary (microscopic), carcinoma in cystic ovaries, carcinoma in solid ovaries, ectopic tubal pregnancy with tuberculous salpingitis

#### LORETTO HOSPITAL

HARVEY LITTLE and NICHOLAS BALSANO—9 Operative clinic Gynecological

#### MICHAEL REESE HOSPITAL

Staff—9 Dry clinic  
A. F. LASH Early treatment of puerperal sepsis peritonitis  
H. STRAUSS and S. MESTROW Ball method of cephalopelvimetry  
I. F. STEIN Gynecography  
M. R. COHEN Clinical use of pregnenolone.  
FRANK RUBOVITS Serum therapy in shock or hemorrhage.  
E. J. DeCOSTA Further development of the photostethoscope.  
J. LACKNER and A. TULSKY Effect of prephysin on the ovary

#### PRESBYTERIAN HOSPITAL

N. SPROAT HEANEY, AARON KANTER, EDWARD C. ALLEN, A. KLAUWANS, FRED PRIEST, and HARRY BOISEN—9 Operations Gynecological

#### RESEARCH AND EDUCATIONAL HOSPITALS

F. H. FALLS and staff—2 Operative and dry clinic  
W. H. BROWNE Low cervical cesarean section.  
J. R. WOLFF Six cases of early carcinoma of cervix uteri  
R. A. LIFVENDAHL Vaginal hysterectomy for prolapse uterus  
F. H. FALLS Vaginal hysterectomy for fibroids  
H. H. HILL Report of two cases of ovarian pregnancy  
A. F. LASH Supracervical hysterectomy

#### Scientific Exhibit

Essentials of prenatal care, puerperal sepsis, care of the premature infant, ectopic pregnancies

#### ST ANNE'S HOSPITAL

J. L. FLEMING—1 Dry clinic Hematogenous streptococcus puerperal infection, chorionepithelioma of fallopian tube, inversion of uterus  
R. J. HAWKINS—1 Essential delivery room equipment

#### SWEDISH COVENANT HOSPITAL

R. A. LIFVENDAHL, G. F. HIBBERT, G. L. ROSENE, and H. J. TIMMERMAN—9 Vaginal hysterectomy, cesarean section case studies

#### WASHINGTON BOULEVARD HOSPITAL

PAUL C. FOX—9 Operative and dry clinic

#### WOMEN AND CHILDREN'S HOSPITAL

AMELIA GRILOTAS, ELOISE PARSONS, PEARL STETLER, MARY EDITH WILLIAMS, and MAUDE HALL WINNETT—9 Surgical and gynecological operations  
BEATRICE TUCKER—9 Operations  
BERTHA VAN HOOSSEN—9 Demonstration Teaching gynecology by models

#### Thursday

#### CHICAGO LYING-IN HOSPITAL

FRED L. ADAIR, WILLIAM J. DIECKMANN, M. EDWARD DAVIS, H. CLOSE HESSELTINE, and FRANKLIN F. SNYDER—9 Operations  
FRED L. ADAIR and staff—2 Dry clinic  
WILLIAM J. DIECKMANN Results of treatment of toxemia patients  
M. EDWARD DAVIS Rational endocrine therapy in obstetrics and gynecology  
ALLAN T. KENYON Metabolic influences of the steroid hormones  
MELBOURNE W. BOYNTON Present-day management of the menopause.  
KATSUJI KATO Vitamin K deficiency in the newborn  
ALICE CHILDS Heart disease in pregnancy  
DONALD M. SCHUTTEMA Subject to be announced

#### COLUMBUS HOSPITAL

CHANNING BARRETT—9 Operations

#### COOK COUNTY HOSPITAL

E. W. FISCHMANN—9 Gynecological operations  
J. P. GREENHILL—10 Gynecological operations

#### GRANT HOSPITAL

FREDERICK H. FALLS—9 Gynecological operation  
E. W. FISCHMANN—2 Gynecological operation

#### HOLY CROSS HOSPITAL

P. E. LAWLER. Manikin demonstration  
F. F. FRAIDER and N. B. PAVLETIC Hysterectomy  
F. J. SALETTA Hysterectomy

#### ILLINOIS MASONIC HOSPITAL

F. O. BOWE and PAULINE LANGE—9 Cesarean section  
DANIEL W. JEFFRIES and R. LEVISOHN—9 Ventral fixation of uterus  
HAROLD W. MILLER and GLEN NELSON—10 Hysterectomy  
ALLAN H. FERGUSON—10 Perineorrhaphy  
A. J. SCHOENBERG and M. OWEN WILKINS—11 Amputation of cervix.

#### NORWEGIAN AMERICAN HOSPITAL

B. W. BREISTER—9 Indications for cesarean section  
P. F. SNYDER—11 Differential diagnosis of uterine tumors

## PASSAVANT MEMORIAL HOSPITAL

ARTHUR H. CURTIS and GEORGE H. GARDNER—g. Operative and dry clinic—Vaginal plastic procedures and abdominal total hysterectomies.  
D. VID S. HILLIS and associates—s. Dry clinic. Cephalopelvic disproportion.

## RESEARCH AND EDUCATIONAL HOSPITALS

## Scientific Exhibit

Essentials of prenatal care—postpartal sepsis—care of the premature infant—ectopic pregnancies.

## ST LUKE'S HOSPITAL

Staff—o. Operations.

## Friday

## CHICAGO LYING-IN HOSPITAL

FRED L. ADAMS, WILLIAM J. DITCHEKOFF, M. EDWARD D. TH. H. CLOKE HERMELTIVE, and FRANKLIN F. SVETTER—g. Operations.

FRED L. ADAMS and staff—s. Dry clinic.

FRED L. ADAMS. Treatment of sterility prolapse.  
FRANKLIN F. SVETTER. Subject to be announced.  
H. CLOKE HERMELTIVE. Management of chronic and resistant vaginal trichomoniasis.  
HILGER P. JENKIN. Acute appendicitis of pregnancy.  
LEONIE HIG. Transportation of gonococcal cultural material.  
FRANCIS OTTO. Venting as complication of obstetrical asphyxia.

## COOK COUNTY HOSPITAL

WILLIAM H. BROWN—g. Gynecological operations.  
FREDERICK H. FALLS—g. Gynecological operations.  
ALBERT DARG. Use of epinephrine in acute inflammation of the uterus.  
LOUIS RUDOLPH. Ring of uterus constriction.  
JAMES E. FITZGERALD. Heart disease in pregnancy.  
D. VID S. HILLIS. Recognition of cephalopelvic disproportion.  
A. OTIS WINTER. Vitamin K in pregnancy.

## MICHAEL REESE HOSPITAL

WILLIAM KEMMITS—g. Neugebauer LaForte operation for prolapse.  
RALPH REIS—g. Vaginal hysterectomy.  
L. F. STEIN—g. Bilateral ovarian resection.  
M. L. LAYNTHAL—g. Manchester operation for prolapse of uterus.

## MT SINAI HOSPITAL

A. E. KASPER and LOUIS RUDOLPH. Gynecological operations.  
A. F. LAKE. Vaginal hysterectomy.  
H. BUTCHER, C. NEWBRED, and A. H. GOLDSTEIN. Obstetrical clinic.

## RESEARCH AND EDUCATIONAL HOSPITALS

F. H. FALLS and staff—s. Operative and dry clinic.  
G. H. RUDOLPH. Supracervical hysterectomy.  
A. J. KOWE. Report of three cases of interstitial ectopic pregnancy.  
W. H. BROWN. Veliectomy.  
R. A. LEVYDORF. LaForte operation for prolapse of uterus.  
V. C. FRIED. Skin test for pregnancy.  
F. H. FALLS. Vaginal hysterectomy under local anesthesia.

## Scientific Exhibit

Essentials of prenatal care—postpartal sepsis—care of the premature infant, ectopic pregnancies.

## ST ELIZABETH'S HOSPITAL

B. S. MILTON—g. Hysterectomy for fibroid tumor—discussion of pathology of fibroid tumors.  
J. K. RAY—Tumors of the uterus.  
J. R. LAYTON and F. J. WALLIS—g. Surgical complications in obstetrics.

## Do to be A nurse!

## HOSPITAL OF ST ANTHONY DE PADUA

M. A. WINTER. Obstetrical operations.

## GENTTO-URINARY SURGERY

## Tuesday

## EVANSTON HOSPITAL

JAMES I. FARRELL—g. Infections of the urinary tract.

## MICHAEL REESE HOSPITAL

Staff—g. Dry clinic.  
GERTA KOCHNER. Carcinoma of breast successfully treated with mastopexy.  
IRVING S. KOLL. Malignant renal calculi.  
HARRIS C. ROUSSE. Radical perineal prostatectomy.  
A. E. JONES. Hydrocephalus due to retroperitoneal lymphosarcoma.  
IRVING SHARON. Ureteral injuries in gynecological operations.  
FREDERICK LEVYDORF. Tumors of kidney.  
J. S. GROVE. Ureteral calculi in case of solitary kidney ureters.

## PRESBYTERIAN HOSPITAL

HERMAN L. K. STROCHER, ROBERT HERBERT NOBLE, J. HODGELL, and JAMES MERRICKS—g. Operative clinic and demonstration of cases.

## RAVENSWOOD HOSPITAL

Staff—g. Demonstration of cases.

## ST JOSEPH HOSPITAL

Staff—g. Dry clinic.

## WESLEY MEMORIAL HOSPITAL

VICTOR D. LEONHART—g. Operative and dry clinic.  
DONALD K. HINES—g. Operative and dry clinic.

## W. JAMES

## ALBERT MERRITT BILLINGS HOSPITAL

CHARLES B. HOGGINS—g. Operative and dry clinic.

## HENROTIN HOSPITAL

C. O. MILLER—g. Neoplasm of the kidneys.

## LORETTO HOSPITAL

CARL J. UEBER—g. Operative and dry clinic.

## MERCY HOSPITAL

H. F. LARSEN—g. Clinical cystometry as aid in the diagnosis of disturbances of micturition.

MICHAEL REESE HOSPITAL

G. KOLISCHOFF, I. S. KOLL, J. S. EISENSTADT, H. C. ROLNICK, A. F. JONES, I. J. SHAPIRO, F. LIEBFERMAN, and J. GROVE—9 Operations

MUNICIPAL TUBERCULOSIS SANITARIUM

D. F. RUDNICK—9 Genito urinary tuberculosis

ST ANNI'S HOSPITAL

H. J. DOOLY and C. C. SAPHOR—9 Operations  
H. J. DOOLY—1 Anesthesia in genito urinary surgery  
C. C. SAPHOR—1 Surgery of prostate in diabetics discussion and demonstration

ST BERNARD'S HOSPITAL

A. J. SULLIVAN—9 Prostatic operations

SWISS COVENANT HOSPITAL

B. I. ILIUS, J. T. GERSON, and K. D. KOHLSTEDT—9 Genito urinary problems

VICTIMS ADMINISTRATION FACILITY

T. G. McDONNELL—9 Operations

Thursday

ALIXIAN BROTHERS' HOSPITAL

JULIUS M. GLASSER—9 Prostatectomy, 2 cases  
EDWARD I. HESS—9 Dry clinic Nephrotomy, cystoscopy and pyelography  
EDWARD W. WHITE—10 Prostatic electroresection, ureteral stone  
A. J. WOCHINSKI—10 Prostatic electroresection, fulguration of bladder tumor 2 cases

CHICAGO MEMORIAL HOSPITAL

VINCENT J. O'CONNOR, JOHN P. O'NEIL, J. WILLIAM PALMER, and KENNETH DORR—9 Operative and dry clinic

CHILDRIN'S MEMORIAL HOSPITAL

HERMAN I. KRETSCHMER—9 Operative clinic and demonstrations Urological problems in infancy and childhood

COLUMBUS HOSPITAL

WILLIAM H. GRUBB—9 Transurethral prostatic resection

GRANT HOSPITAL

EDWARD I. HESS—9 Demonstration of case  
WILLIAM H. GRUBB—9 Operations

ILLINOIS MASONIC HOSPITAL

WILLIAM H. GRUBB and F. I. CHAMOWITZ—9 Nephrectomy  
C. OTIS RITCH and O. I. HARRIS—9 Suprapubic cystostomy

EDWARD W. WHITE and CHARLES MURRAY—10 Prostatectomy

R. B. GATES—10 Nephrolithotomy

CLARENCE C. SAPHOR—11 Cystoscopic examination

MICHAEL REESE HOSPITAL

G. KOLISCHOFF, I. S. KOLL, J. S. EISENSTADT, H. ROLNICK, A. E. JONES, I. J. SHAPIRO, F. LIEBFERMAN, and J. S. GROVE—9 Operations

NORWELIAN AMERICAN HOSPITAL

D. F. RUDNICK—10 Transurethral resection of prostate

PASSAUNT MEMORIAL HOSPITAL

LEONARD W. RINA—2 Dry clinic Chronic female urethritis and its treatment  
L. J. VESPER—3 Diagnosis and treatment of tumors of the testes

ST LUK'S HOSPITAL

L. L. SCHMIDT and staff—9 Operative and dry clinic

WASHINGTON BOULEVARD HOSPITAL

VINCENT J. O'CONNOR—9 Operative and dry clinic

Friday

MT SINAI HOSPITAL

H. C. ROLNICK—9 Operations

ST ELIZABETH'S HOSPITAL

T. G. McDONNELL—3 Nephrectomy, discussion of tumors of the kidney

Saturday

COOK COUNTY HOSPITAL

HARRY CULVER, HARRY C. ROLNICK, D. F. RUDNICK, and L. L. VESPER—9 Operations

HOSPITAL OF ST ANTHONY DE PADUA

OTTO JIRSA—9 Operative and dry clinic Cystoscopy

RISARCH AND EDUCATIONAL HOSPITALS

C. M. McKINNA, J. H. KIRFFER and staff—9 Operative and dry clinic Transurethral resection for hypertrophied prostate gland suprapubic operation for hypertrophied prostate gland nephrostomy and removal of aberrant vessels for hydronephrosis repair of undescended testicle total cystostomy following transplantation of ureters for bladder exstrophy and result of correction of hypospadias, and results of repair of undescended testicle

R. C. HERFOLD—9 Evaluation of urinary antiseptics in treatment of infections

## TRAJECTURES AND OTHER TRAUMAS

Sunday

COOK COUNTY HOSPITAL

WILLIAM K. CURRIS, J. J. CATTARA, and C. S. SAMPSON—9 Operative clinic

Monday

CHICAGO MEMORIAL HOSPITAL

I. C. BROWN, EDWARD I. CAYLE, ARTHUR H. COWLEY, EDWARD DEWITT, K. G. FORTINER, A. H. MASON, and M. MURPHY—9 Prostatectomy

STROSS and GEORGE M. LANDAU—9 Operative and dry clinic

C. K. FORTINER—9 Shoulder fracture

A. H. MASON—9 Fractures of the scapula

FRANK M. MILLER and T. C. LEROY—9 Fractures of forearm and angle

FRANK J. CONLEY—9 Fracture of humerus

S. JEFFERSON—9 Fracture of femur

EDWARD DEWITT—9 Fracture of femur

HOPKINS—9 Fracture of femur

## EVANSTON HOSPITAL

MARCEL H. HOWART—Malunited Colles fracture.  
DUNCAN F. CLARK—Intraosseous splinting with cow's  
horn—four-year end result.

## RAVENSWOOD HOSPITAL

Staff—o. Demonstration of cases.

## ST JOSEPH HOSPITAL

HUGH McKERRA—o. Demonstrations, Motion pictures  
and slides of fractures of the neck of femur and demon-  
stration of device used in securing dry films during  
the stage of reduction.

## WASHINGTON BOULEVARD HOSPITAL

ARTHUR R. METZ—o. Operative and dry clinic.

## Wednesday

## CHILDREN'S MEMORIAL HOSPITAL

ALBERT H. MONTGOMERY, J. A. IRELAND, and W. J. POTTS  
—jo. Demonstration of cases. Fractures of forearm,  
supracondylar fractures of humerus, bone cysts, skull  
fractures.

## COOK COUNTY HOSPITAL

GEORGE L. APPERSON—s. Operative clinic. Flange opera-  
tion for fractured neck of femur; open reduction of the  
forearm with intraosseous peg; reconstruction of  
malunited Colles fracture.

## HENROTIN HOSPITAL

RAIMOND KORDENAT—o. Operations.  
JOHN A. GRUBER—o. Demonstration, with lantern slides.  
Fracture of distal end of radius.  
JOHN J. ECKHART—o. Dry clinic. Care of fractures.

## JACKSON PARK HOSPITAL

F. G. MCKINNEY—o. Operations.

## MERCY HOSPITAL

F. C. JACOBSEN—s. Industrial fractures.  
JOHN D. CLARKE—s. Fractures of the humerus.  
J. M. LINDEN—s. Forearm fractures.

## PASSAUNT MEMORIAL HOSPITAL

P. T. B. MACKINTOSH and JAMES K. STACE—s. Dry clinic.  
Joint dislocation—cases (Waxing end results of treat-  
ment of traumatic arthritis).

## ST ANNE'S HOSPITAL

J. J. CASARA—Dry clinic. Shoulder-labrum con-  
genital dislocation of patella.  
T. E. MEANT—Dry clinic. Fracture of femur in children  
—Paget's disease.

## SWEDISH COVENANT HOSPITAL

O. T. ROSSIGNOL and O. T. ROSSIGNOL, JR.—o. Fractures.

## Thursday

## COLUMBUS HOSPITAL

GEORGE REYNOLDS—o. Dry clinic.

## COOK COUNTY HOSPITAL

WILLIAM R. COHEN and JAMES J. CALLAN—  
Operations.

## NORWEGIAN AMERICAN HOSPITAL

H. A. SORSTED—Steel pin fixation of fractures of neck  
of the femur.

## Friday

## COOK COUNTY HOSPITAL

COOK COUNTY GRADUATE SCHOOL OF MEDICINE  
Staff—Demonstration on cadaver. Fractures and  
traumatic surgery.

## PRESBYTERIAN HOSPITAL

Staff—o. Operative and dry clinic.  
EDWIN M. MILLER—Improved methods in dealing with  
supracondylar fractures of the elbow; resection of  
tumor of acetabular bone with free graft from tibia,  
—rays, microscopic pathology and clinical result.  
WILLIS J. POTTS—Improved method of amputation  
of fractures of both bones of leg.  
EDMUND FIELD—Fractures of the capitulum of the  
humerus.  
EDWARD L. COMPTON—Elimination of methods of in-  
ternal fixation of fractures of neck of the femur.  
E. J. BRIDGEMAN—Dislocations of cervical vertebrae;  
arthrodesis of shoulder; tendon transplants.  
KILLGUS SUTTON—Reconstruction problems following  
trauma in hip region, illustrated talk on sounds of  
air fractures about elbow.

## To be announced

## HOSPITAL OF ST ANTHONY DE PADUA

F. W. SLONE—Operative clinic. Fractures, tendon suture;  
care of sounds treatment of bones.

## ORTHOPEDIC SURGERY

## Monday

## CHILDREN'S MEMORIAL HOSPITAL

FREDMONT A. CHANDLER, F. SEIDLER, C. N. PEARL, J. R.  
NORCROSS, and L. SMITH—jo. Operative and dry  
clinic. Osteomyelitis resection of ulna; pure infection  
of joint, tuberculosis metatarsal and tuberculous ankle-  
patellar advancement, radial stripping for pronation de-  
formity; unusual tumor of femur; unusual tumor of  
ulna; anterior dislocation of hip; torticollis, six cases.  
Erb palsy; back lacer; neural dislocation of patella,  
anchochondria, six cases; osteochondromatosis of hip  
in overgrowth of spine.

## RESEARCH AND EDUCATIONAL HOSPITALS

H. B. THOMAS, I. W. HARR, C. N. LUDWIG and S. L.  
COHEN—Operative and dry clinic. Fusion of tuber-  
culous hip—end-results of tuberculosis of hip and spine;  
tendon transplant to shoulder; results of tendon trans-  
plant for brachial plexus injury to shoulder; use of shift  
cups in treatment of scoliosis.

## Tuesday

## CHILDREN'S MEMORIAL HOSPITAL

FREDMONT A. CHANDLER, F. SEIDLER, C. N. PEARL, J. R.  
NORCROSS, and L. SMITH—o. Operative clinic. Extra

peritoneal resection of obturator nerve two cases, Lowman operation for flat feet triple arthodesis, Chandler patellar advancement operation spine fusion, torticollis four to five weeks of age, hip fusion operation, popliteal neurectomy

### COOK COUNTY HOSPITAL

ARTHUR H. CONLEY and DONALD MILLER—9 Operations  
MARCEL H. HONART and ELLIS JANSKY—10 Operative clinic Shoulder injuries

### EVANSTON HOSPITAL

R. C. TONERCAN—9 Operative clinic Internal derangement of knee

### MICHAEL RIESE HOSPITAL

PHILIP LEWIN, D. H. EVANTHAL, SIDNIA SIDEMAN, IRVING WOLIN, C. N. PIASE, IRVING GLASSMAN, and J. G. FINDER—9 Operative clinic Spinal fusion for scoliosis, Hoke arthodesis for paralytic foot, laminectomy for intervertebral disc protrusion, poliomyelitis reconstruction knee joint operation hip joint operation

### ST. JOSEPH HOSPITAL

Staff—9 Demonstrations Lantern slides and moving picture of fractures

SHIRINIS HOSPITAL FOR CRIPPLED CHILDREN  
B. H. MOORE and H. A. SONNED—9 Operative clinic

### WISLEY MEMORIAL HOSPITAL

ELLIS M. JANSKY—9 Operative and dry clinic  
PHILIP H. KRETSCHER—10 Operative and dry clinic  
HAMMER KRELLMAN—11 Operative and dry clinic  
O. H. HORRALL—11 Operative and dry clinic

### Wednesday

### COOK COUNTY HOSPITAL

PHILIP LEWIN and SIDNIA SIDEMAN—9 Operative clinic  
DANIEL H. EVANTHAL and staff—9 Dry clinic  
DANIEL H. EVANTHAL—9 Operative clinic Derangement of the knee joint spinal fusion arthroplasty of hip using vitallium cup arthodesis of foot for poliomyelitis

### LORFETTO HOSPITAL

BEVERLY MOORE, JAMES A. VALENTINI, and IRVING CARLS—10 Operative and dry clinic

### MICHAEL RIESE HOSPITAL

Staff—2 Dry clinic Dunlop traction treatment of transcondylar fractures of the elbow in children Risser method in scoliosis club feet Legg Calve Perthes lesion, tuberculosis of the hip joint tuberculosis of the spine chronic osteomyelitis, rickettic deformities post-operative laminectomy for disc protrusion, open reduction of congenital hip dislocation flexorplasty of thumb, spina bifida with paraplegia vitallium cup hip arthroplasty leg equalization by epiphyseal arrests, leg shortening

### PASSAVENT MEMORIAL HOSPITAL

PAUL B. MACLESON and JAMES K. STACK—3 Dry clinic Joint debriement cases illustrating end results of treatment of traumatic arthritis

### ST. ANNE'S HOSPITAL

J. J. CALLAHAN and R. E. MANN—9 Operations

### ST. LUKE'S HOSPITAL

HENRY B. THOMAS—10 Bone changes in connection with thyroid disease

IRVING W. HARK—10 Bone changes in connection with sickle-cell anemia

CLAUDE N. LAMBERT—10 Bone tumors

H. I. MOCK, ALVIN R. MORROW, CHARLES I. SHANNON, JOHN J. TISHBOSTER and DONALD C. HOWE—11 Dry clinic Conservative treatment of fractures of neck of femur, fractures of fingers and toes, supracondylar fractures of humerus malunited fractures of ankle

JOHN W. TILDS—11 Compression fractures of vertebrae using Ryerson hyperextension device

EDWIN W. RYKESON—130 Dry clinic Shelf operation at hip reconstruction of hip joint, osteotomy to produce black knee

IRLMONT W. CHANDLER—9 Operative clinic Aseptic necrosis of head of femur

ROBERT I. RITTIG—230 Arthroplasty

HAROLD A. SONNED—3 Discussion of leg lengthening operations indications and technique

Open forum—330

SHIRINIS HOSPITAL FOR CRIPPLED CHILDREN  
Staff—3 Clubfoot clinic

### VETERANS ADMINISTRATION FACILITY

S. K. IVERSTON—10 Dry clinic Peripheral vascular diseases

### Thursday

### ALVIN BROTHERS' HOSPITAL

GEORGE I. AUFENBACH—10 Demonstration of examination for lower back pain, non union of neck of femur

### ALBERT MERRITT BILLINGS HOSPITAL

CYRIL HATCHER and DALLAS B. PHILLISTER—9 Operative and dry clinic

### COLUMBUS HOSPITAL

IRVING RICK MULLER—930 Dry clinic

### COOK COUNTY HOSPITAL

IRVING G. MURPHY and WALTER FISCHER—9 Operations  
I. J. BIRKMEIER—10 Operations

ARTHUR H. CONLEY and staff—10 Dry clinic

### GRANT HOSPITAL

JOSEPH I. ALIFERRITI—2 Treatment of arthritis

GEORGE I. AUFENBACH—2 Demonstration of examination for lower back pain, open reduction of fracture

### HOLY CROSS HOSPITAL

C. P. GALANTI Rare bone tumors

### ILLINOIS WASONIC HOSPITAL

CHARLES N. PEASE—9 Fixation of hip

WALTER R. FISCHER—10 Osteomyelitis

### MICHAEL RIESE HOSPITAL

PHILIP LEWIN, D. H. EVANTHAL, SIDNIA SIDEMAN, IRVING WOLIN, C. N. PIASE, IRVING GLASSMAN, and J. G. FINDER—9 Operative clinic Spinal fusion for scoliosis, Hoke arthodesis for paralytic foot, laminectomy for intervertebral disc protrusion, poliomyelitis reconstruction, knee joint operation, hip joint operation

### RLS ARCH AND EDUCATIONAL HOSPITALS

II. B. THOMAS, I. W. HARK, C. N. LAMBERT, and S. L. ODEFFS—2 Operative and dry clinic Open reduction for slipped epiphysis of the femur and insertion of fibular graft through neck, end results of hip joint surgery, particularly fractures and epiphyseal separations

## SHIRNERS' HOSPITAL FOR CRIPPLED CHILDREN

B. H. MOORE and H. A. SORRELL—*g*. Operative clinic.

## Fid y

## COOK COUNTY HOSPITAL

FRED HARR and CLAUDE LAMBERT—*g*. Operations.  
H. KELLEY and GRAHAM A. KERNSTEN—*g*. Operations.

## SIT SIN HOSPITAL

C. L. JACOBS and LEO F. MILLER—*g*. Operations.

## PASSAVANT MEMORIAL HOSPITAL

EARL HARTER—*g*. Case presentation: Fusion of hip for tuberculous spinal fusion, presenting an unusual complication. Brodie's abscess, illustrating results of chemotherapy after result of treatment of delayed union in fracture of humerus after treatment for fracture of calcaneus.

## ST MARY OF NAZARETH HOSPITAL

L. M. CAY—*g*. Operations.

## THORACIC SURGERY

## Tuesday

## COOK COUNTY HOSPITAL

JEROME R. HEAD—*g*. Dry clinic.  
R. B. BETTMAN—*g*. Operative clinic.

## EVANSTON HOSPITAL

JEROME R. HEAD—*g*. Operations.

## RESEARCH AND EDUCATIONAL HOSPITALS

WILLARD A. HAZEL—*g*. Operative and dry clinic. Thoracoplasty, thoracotomy for chronic emphysema, discussion of surgical drainage of lung abscess, lobectomy for bronchiectasis.

## Hedford

## VETERANS ADMINISTRATION FACILITY

JEROME R. HEAD—*g*. Dry clinic: Thoracoplasty.

## Thursday

## ALEXIAN BROTHERS' HOSPITAL

MIRIAM J. VOYLES and LOUIS J. MILLER—*g*. Operative clinic. First-stage thoracoplasty: extrapleural pneumothorax, antillary approach, lobectomy for bronchiectasis. Dry clinic. Hurler's syndrome, clinical and radiological aspects, chronic suppuration of the lung in relation to carcinoma of the lung.

## Tuesday

## ST LUKE'S HOSPITAL

ERIC OLDBERG and WALTER A. GASTAFSON—*g*. Operations and demonstrations.

## Hedford

## COOK COUNTY HOSPITAL

HAROLD C. VOYLES—*g*. Dry clinic. Operative treatment of head injuries.  
ADRIAN VERRILL, GREEN and associates—*g*. Operations.

## PASSAVANT MEMORIAL HOSPITAL

LOY D. VES and JOHN MARTIN—*g*. Dry clinic. Discussion of results of surgical treatment of essential hypertension, discussion of tumors of the nasopharynx, producing intracranial symptoms.

## Thursday

## COOK COUNTY HOSPITAL

ADRIAN VERRILL, GREEN and associates—*g*. Dry clinic. Concomitant of the brain.

## ILLINOIS MASONIC HOSPITAL

MIRIAM J. VOYLES and L. J. MILLER—*g*. Extrapleural pneumothorax.

## MICHAEL REESE HOSPITAL

S. L. GOLDBERG—*g*. Stab wound of pericardium and lung.  
NATHAN V. CHORN—*g*. Concepts in treatment of emphysema.MAX BIRNBAUM—*g*. A two-year review of collapse therapy in treatment of tuberculosis.R. B. BETTMAN and WILLIAM TAYLOR THOMAS—*g*. Surgical approach to thoracic esophagus.R. B. BETTMAN—*g*. Dry clinic. Interesting cases in thoracic surgery.DR. LEVY—*g*. Anesthesia in thoracic surgery.

## Friday

## MICHAEL REESE HOSPITAL

R. B. BETTMAN and WILLIAM TAYLOR THOMAS—*g*. Operations.

## MUNICIPAL TUBERCULOSIS SANITARIUM

MIRIAM J. VOYLES—*g*. Collapse therapy clinic.

## PRESBYTERIAN HOSPITAL

JOHN M. DORSEY—*g*. Operations.

## NEUROSURGERY

## MERCY HOSPITAL

HAROLD C. VOYLES—*g*. Dry clinic. Protruding intervertebral disc.

## MICHAEL REESE HOSPITAL

ADRIAN VERRILL, GREEN—*g*. Operative and dry clinic.

## Friday

## PRESBYTERIAN HOSPITAL

JOHN M. DORSEY—*g*. Operations.

## ST LUKE'S HOSPITAL

ERIC OLDBERG and WALTER A. GASTAFSON—*g*. Operations and demonstrations.

## Days to Be Announced

## RESEARCH AND EDUCATIONAL HOSPITALS

ERIC OLDBERG, FREDERAL BULL, WALTER A. GASTAFSON and MILDRED TRAVIS—*g*. Operations and demonstrations.

# OPHTHALMOLOGY

## Tuesday

CHICAGO MEMORIAL HOSPITAL  
FRANCIS M CRAGE, HERMAN P DAVIDSON, and GLENWAY  
NETHERCUT—2 Operative and dry clinic.

EVANGELICAL HOSPITAL  
G HENRY MUNDT, J R SMITH, EVAN A MILLER, and  
J H F O'NEIL—9 Operations

EVANSTON HOSPITAL  
G R SOPER, GLENN J GREENWOOD, and R H HENDER-  
SON—9 Operations

GRANT HOSPITAL  
OSCAR H KRAFT—9 Operative and dry clinic.

ILLINOIS EYE AND EAR INFIRMARY  
THOMAS D ALLEN, V M LEECH, and G W NETHERCUT—  
2 Operative clinic Cataracts, ptosis, glaucoma

PASSAVANT MEMORIAL HOSPITAL  
SANFORD GIFFORD and associates—9 Dry clinic Retina  
detachment, retinoplasty plastic surgery of the eyelids

RESEARCH AND EDUCATIONAL HOSPITALS  
H J SMITH—9 Management of foreign bodies

HALLARD BEARD—9 Surgical treatment of glaucoma

ST JOSEPH HOSPITAL  
Staff—9 Operative and dry clinic

ST LUKE'S HOSPITAL  
ELMER VORISEK—2 Demonstration of cases

WESLEY MEMORIAL HOSPITAL  
PHILIP O'CONNOR—9 Operative and dry clinic

WILLIAM A MANE and IRVING PUNTENNEY—10 Oper-  
ative and dry clinic

## Wednesday

CHILDREN'S MEMORIAL HOSPITAL  
RICHARD GAMBLE and associates—4 Dry clinic

COOK COUNTY HOSPITAL  
JAMES E LEBENSOHN and WILLIAM F MONCREIFF—9  
Operations

ILLINOIS EYE AND EAR INFIRMARY  
PETER C KRONFELD—9 Gonioscopy  
KATHARINE CHAPMAN—9 Orthoptic clinic  
ROBERT VON DER HEYDT—3 Slit lamp demonstration

## Monday

ILLINOIS EYE AND EAR INFIRMARY  
SAMUEL SALINGER—2 Operative and dry clinic Plastic  
surgery about the nose

## Tuesday

ALBERT MERRITT BILLINGS HOSPITAL  
JOHN R LINDSAY—2 Exhibit and demonstration Sup-  
purations of the petrous pyramid, anatomical, pathologi-  
cal, and roentgenological considerations

## MERCY HOSPITAL

CARL F SCHAUB and L G HOFFMAN—9 Operative and  
dry clinic Demonstration of verified cases of optico-  
chiasmatic arachnoiditis

## ST BERNARD'S HOSPITAL

C P SULLIVAN Cataract operations

## SWEDISH COVENANT HOSPITAL

R A DAVIS—9 Operative and dry clinic Glaucoma

## Thursday

## COLUMBUS HOSPITAL

MICHAEL GOLDENBURG—9 Operations

## EVANGELICAL HOSPITAL

G HENRY MUNDT, J R SMITH, EVAN A MILLER, and  
J H F O'NEIL—9 Operations

## ILLINOIS EYE AND EAR INFIRMARY

LOUIS G HOFFMAN—9 Operative and dry clinic Verhoeff  
suture

E K FINDLAY—10 Dry clinic

E K FINDLAY and Dr CORBOY—2 Operative clinic  
ST LUKE'S HOSPITAL  
E V L BROWN—9 Demonstration of cases  
FRANK BRAWLEY and JAMES W CLARK—2 Demonstra-  
tion of cases

## Friday

## COOK COUNTY HOSPITAL

SANFORD R GIFFORD—9 Operations  
EDWARD A ROLING—10 Operations

## ILLINOIS EYE AND EAR INFIRMARY

PETER C KRONFELD—9 Gonioscopy  
KATHARINE CHAPMAN—9 Orthoptics  
SAMUEL J MEYER—2 Operative clinic Cataracts, glau-  
coma

## RESEARCH AND EDUCATIONAL HOSPITALS

CARL APPLE—9 Recession operation for strabismus  
J W CLARK—9 Intracapsular extraction of cataract.

## ST ELIZABETH'S HOSPITAL

F A DULAK and OSCAR CLEFF—3 Operative and dry  
clinic Glaucoma

## ST LUKE'S HOSPITAL

RICHARD GAMBLE—3 Demonstration of cases

# OTOLARYNGOLOGY

## CHICAGO MEMORIAL HOSPITAL

OSCAR CLEFF, ALFRED LEWY, ROBERT LEWY, JAMES B  
MCBEAN, GORDON H SCOTT, and RICHARD W WAT-  
KINS—2 Operations

## COOK COUNTY HOSPITAL

JACOB LIFSCHUTZ—2 Operative and dry clinic  
RAYMOND W KERWIN—2 Operative and dry clinic

## EVANGELICAL HOSPITAL

G HENRY MUNDT, J R SMITH, EVAN A MILLER, and  
J H F O'NEIL—9 Operations



## EVANSTON HOSPITAL

T. C. GALLON—H. C. BALLENGER, and L. J. LAWSON, Operations.  
T. C. GALLON—Aerobic bone infections about the head.

## ILLINOIS EYE AND EAR INFIRMARY

T. P. O'CONNOR—g. Plastic surgery demonstration of patients, lantern slides, etc.  
C. R. CANNON—g. Operative clinic: Radical mastoid.  
E. J. BLOCHER—g. Labyrinthine diagnosis and demonstration of the galsak following reaction.  
M. A. GLATT—g. Operative clinic: Radical mastoid and external frontal.

## RESEARCH AND EDUCATIONAL HOSPITALS

P. H. HOLINGER and A. H. ANDREWS, J.—g. Bronchoscopies.  
F. L. LUTHER and staff—Otorhinolaryngological operations.

## ST. JOSEPH HOSPITAL

Staff—g. Operative and dry clinic.

## WESLEY MEMORIAL HOSPITAL

T. P. O'CONNOR and LEONARD C. DELLORE—Operative and dry clinic.  
T. M. TOWS CURRIE—Operative and dry clinic.

*Medical*

## COOK COUNTY HOSPITAL

S. J. FRANKMAN—Operative and dry clinic.  
JACOB LERNER—Operative and dry clinic.

## ILLINOIS EYE AND EAR INFIRMARY

DR. WOODRUFF—Laryngeal stents and ear cancer: endonasal mastoid and stapes surgery.  
T. P. O'CONNOR—g. Operative clinic.

## JACKSON PARK HOSPITAL

V. A. FOX—g. Operations.

## PASSAUNT MEMORIAL HOSPITAL

JOHN F. DEER and associates—g. Dry clinic: Laryngoscopic bronchoscopy: esophagoscopy presentation of exhibits and cases, carcinoma of larynx.

## ST. ANNE'S HOSPITAL

J. W. H. YOUNG—g. Operations.

## ST. MARY OF NAZARETH HOSPITAL

F. J. FRANKLIN—g. Otolological operations.

## VETERANS ADMINISTRATION FACILITY

MAX CUTLER—Dry clinic: Carcinoma of the mouth and larynx. Problems in diagnosis and treatment, indications for surgery and irradiation in laryngeal carcinoma, presentation of cases.

*Throat*

## ALBERT MERRITT BILLINGS HOSPITAL

JOHN R. LINTON—Exhibit and demonstration: Separations of the petrous pyramid: anatomical, pathological, and roentgenological considerations.

## COOK COUNTY HOSPITAL

RAIMOND W. KIRK—Operative and dry clinic.

## EVANGELICAL HOSPITAL

G. HENRY MURPHY, J. R. SMITH, E. A. MILLER, and J. H. F. O'NEILL—g. Operations.

## GRANT HOSPITAL

CARROLL W. STUART—g. Otol surgery.  
S. H. SOMMER—g. Nose and throat operations.

## ILLINOIS EYE AND EAR INFIRMARY

E. J. BLOCHER—g. Operative and dry clinic: Radical mastoid.  
M. A. GLATT—g. Osteomyelitis of the frontal bone.

## ILLINOIS MASONIC HOSPITAL

ALY SOWERS—g. Tonsillectomy.  
ARTHUR GIEGER—g. Deviated septum.  
M. UDEK H. COTTELL and MILTON LAYBURN—g. Mastoidectomy.  
HERBERT E. T. VILOR—Drainage maxillary sinus.  
JOHN GILMORE and PERS J. MELANDER—g. Diagnosis and treatment of carcinoma.

## MERCY HOSPITAL

PETER P. LEIDERMAN—g. Disturbances of equilibrium.  
CARL H. CHRISTENSEN—g. Laryngeal malignancies.  
HERBERT V. ORR—g. Endonasal operations.  
G. T. JORD—g. Anatomy of the temporal bone.

## MUNICIPAL TUBERCULOSIS SANITARIUM

GEORGE HOLMES—g. Bronchoscopy in tuberculosis.

## NORWEGIAN AMERICAN HOSPITAL

M. A. GLATT—g. Control of hemorrhage in tonsillectomy.  
J. W. HANSEN—g. Danger signals in mastoid infection.

## ST. LUKE'S HOSPITAL

P. H. HOLINGER and ALBERT H. ANDREWS, J.—g. Personal endoscopic clinical presentation of bronchial and esophageal cases.  
HORACE R. L. ORR, WALTER H. THORNDIKE and staff—g. Operative and dry clinic: Soliman's therapy in acute sinusitis and acute otitis media, Proctor's treatment for sinusitis.

*F. May*

## CHILDREN'S MEMORIAL HOSPITAL

PART H. HOLINGER and ALBERT H. ANDREWS—g. Bronchoscopic clinic.

## COOK COUNTY HOSPITAL

JACOB LERNER, T. C. GALLON, and R. W. KIRK—g. Operative and dry clinic.

## ILLINOIS EYE AND EAR INFIRMARY

ALFRED LEWY—Operative clinic.

## ST. SINAI HOSPITAL

S. M. MOWITT—g. Operations.

## RESEARCH AND EDUCATIONAL HOSPITALS

L. W. SCHULTZ—g. Operative and dry clinic: Cleft palate operation presentation of interesting cases in oral surgery, stabilization of joints by injecting sclerodag agent, bilateral cleft lip operation, bilateral temporomandibular dislocation for 35 months, reduction, end results with motion pictures, Walcott cup arthroplasty of temporomandibular joint, presentation of case.

## ST. ELIZABETH'S HOSPITAL

J. G. WERT and T. A. CARROLL—g. Operative and dry clinic: Complications in mastoid surgery.

# SURGERY

## GYNECOLOGY AND OBSTETRICS

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### MALIGNANT MELANOMAS

With Report of 4 and 7 Year Cures

JAMES BARRETT BROWN, M D , F A C S , and LOUIS T BYARS, M D ,  
St Louis, Missouri

**M**ALIGNANT melanomas are recognized to be rapidly fatal tumors, and although their number is low in proportion to other malignancies, their occurrence is fairly common. Treatment has often been considered hopeless and therefore a decision as to choice of treatment has been confusing.

Pathologists have referred to the growths both as sarcomas and carcinomas, thus adding to the uncertainty of their origin. The majority of these lesions first appear on the surface of the body where pigment is common, but primary growths have been described in unusual sites, and according to one theory can originate in any ectodermal tissue. They may arise in the skin, the nail bed, the choroid of the eye, the mucous membrane of the mouth, rectum, or vagina, and have been found in the meninges and parotid gland.

Destruction of the precancerous lesion is of prime importance, and since a large percentage of such malignancies arise in pigmented nevi, if these simple looking growths could be removed adequately at the slightest suspicion of growth or activity, many patients might be spared (Fig 11).

The question of removing moles, either for appearance or for the possibility of cancer is

often put to the doctor, and therefore some rules are advisable for determining which moles had best be removed. Nearly everyone has pigmented moles in profusion, but it would be impossible to remove all of them. The safest procedure is to destroy all moles that are subjected to chronic irritation, as in shaving, friction of clothing, combing the hair, fingering because of habit, repeated pulling of hairs, etc., whether they are pigmented or not. Every lesion should be removed that shows evidence of growth, increase in vascularity, change of color, repeated infection or ulceration. The smooth, coal-black nevi should likewise be removed.

In the congenital growth that is apt to be flat and not heavily pigmented, the basement membrane may be lacking and the cells may be scattered all around as they appear in a malignancy, and yet this congenital type rarely actually becomes malignant and might even be considered as an anomaly of the skin rather than a tumor. Dr N A Womack classifies this type of growth as neuro-nevi. On the other hand, the developmental mole that appears at any time during life and progresses in size is probably the type that most often becomes malignant, and this point of whether a growth is congenital or developmental may be of some importance in deciding about removal.

From the Department of Surgery Washington University  
School of Medicine St Louis Mo



Fig. 11. Scar of radical neck dissection for removal of metastatic melanocarcinoma from the temple; here healed scar is also shown. Patient—57 years.

Since there have been instances of activation and the development of cancer by removing or 'fooling' with a common mole, many patients, and doctors as well are afraid of any form of treatment and recommend that all moles be left alone. Unquestionably some practices of therapy are dangerous, such as pastes and acids and even electrodesiccation when done without anesthesia, in which circumstance the inability of the patient to co-operate hurries the operator. It has been noted by others as well as ourselves, that multiple electrodesiccations have been done in many of the terminally fatal lesions.

The removal should be quick, painless, non-irritating thorough and should involve the minimum handling of the growth. In ques-

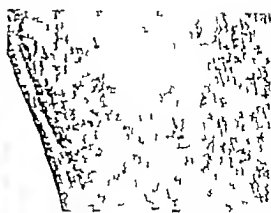


Fig. 12. Photomicrograph of gland showing complete replacement with melanocarcinoma.

cent lesions, clean knife excision, carried out in such a manner is acceptable. Our usual method, however in small lesions is to use novocain without inserting the needle in the growth and then completely and thoroughly to destroy the area with a small pointed electric cautery which is made to penetrate the entire depth of the skin and enter the underlying fat. A circular burn is thus produced that requires dressing for 2 to 3 weeks. The ultimate scar is smaller than the area of destruction and after 6 months the area has usually whitened and smoothed out so that the patient has little objection to the scar (Fig. 11). In a few instances of keloid or heavy scar formation, a repair is made later. For larger lesions, this simple quick cautery excision may also be done but patient should understand repair will be necessary later.

It has been stated that melanomas arising from non-pigmented areas are the most malignant, but so far all we have seen have been pigmented.

#### DIAGNOSIS

The change from an innocent pigmented nevus to a malignancy should not be difficult to detect and diagnose. At its onset there may be an increase in elevation or of surface area, or the skin may retain its usual texture with a deepening of pigmentation to a velvety black. Other early signs are an increase in vascularity and an apparent chronic infection with slight tenderness. The appearance of an

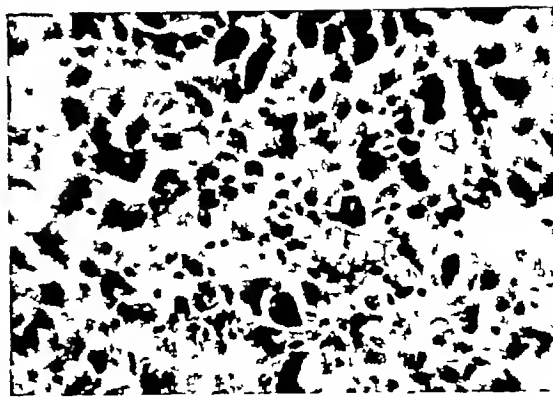
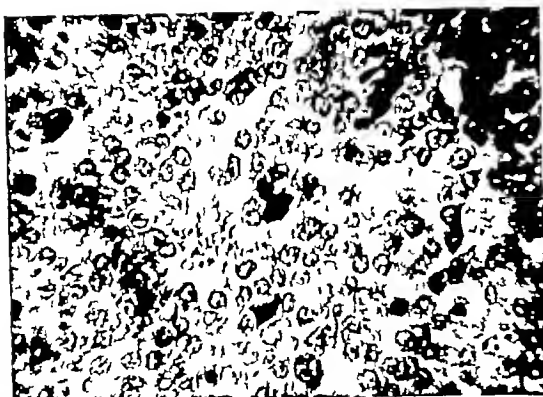


Fig 2 a, left, Photomicrograph of primary tumor in parotid gland b, Skin metastases from melanocarcinoma of parotid

entirely new growth may be difficult to diagnose as a melanoma, but a localized process in the skin or under the nail presenting an increase in bulk and lacking the pain and tenderness of an infection and the characteristics of a wart should at least be considered as a malignant neoplasm. Obvious melanin may not be present, one such lesion on the heel in our series had two small flecks upon its surface which could have been taken for tiny blood clots (Fig 9)

#### TREATMENT

*Malignant melanomas of the face and head*  
*The local lesion* Death almost never occurs from extension or erosion of the local lesion,

as may be the case in other malignancies of the face. This is probably due to the fact that hopeless metastases and death occur so rapidly.

Treatment is limited to surgery since there is almost complete agreement that melanomas are resistant to radiation. This does not mean that most any method of local eradication may suffice or be of equal safety, and it is certain that tampering with the local lesion by anything less than complete wide removal is merely inviting trouble. The surgical procedure should be quick, should avoid all irritation of the lesion, should require the minimum handling of the field, and should remove a generous margin of normal surrounding skin. In addition, the un-



Fig 3 a left Healed scar of removal of black mole from lobe of ear and metastasis below jaw 2½ years later b Scar of thorough but limited dissection. Patient died accidentally 1½ years later without recurrence





Fig 6 Primary melanocarcinoma of the parotid with paralysis of the seventh nerve. Death some months after radical operation

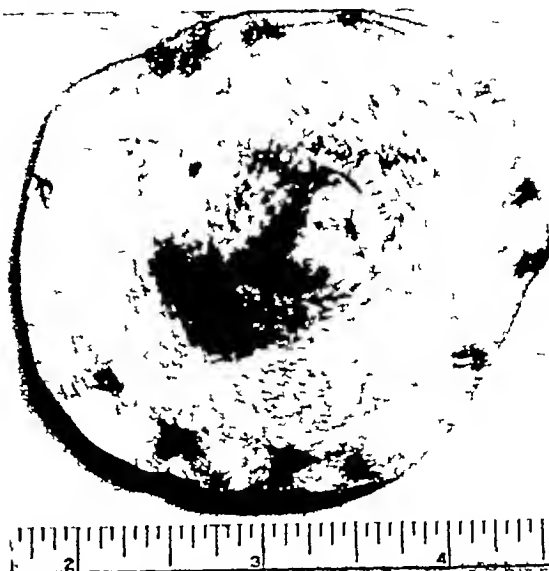


Fig 7 Primary scalp melanocarcinoma developing in an old mole. No regional gland involvement but death with stomach metastases

Because of the relationship between the pituitary secretion and the melanophore system, Wigby and Metz<sup>1</sup> treated such a patient in June, 1938, with x-ray therapy to the pituitary gland. At the date of their publication in February, 1939, there had been complete retrogression and recovery of the patient. Patients treated subsequently, which were not of this type but fell in the group of local gland involvement did not respond (Fig 8)

4 The local lesion may remain cured but later, from a few months to 25 years, the patient may die of a visceral metastasis. Most of the patients with a long period of alleviation seem to have had the original lesion in the choroid of the eye. This must be a blood stream spread, but the malignant cells may have been resting in the glands.

5 The last group and the most important, because it is in these that some hope of cure may be held, contains those in which the primary focus is eradicated and the metastasis appears in the regional lymph nodes, there to be held in check for some indefinite period. Radical block dissection of the neck has shown definite promise and gives patient his only chance for life (Figs 1, 3, 4, 5)

Some patients may show all methods of metastases: local skin, glands, distant skin, and visceral involvement through the blood stream.



Fig 8 Multiple skin metastases from irritated mole on forehead. Also had lymphatic involvement and blood stream metastasis to the lungs.

<sup>1</sup>Am J Roentgenol. 1939 41 415



Fig. 9. Melanocarcinoma. (a) ulceration of 6 months' duration. (b), right, Result of wide removal and grafting. Inguinal involvement was removed. (c) no recurrence, but death from abdominal metastases resulted in 5 months.

A problem in treatment brought up by a consideration of these methods of spread concerns whether or not prophylactic regional gland dissections should be done. Against prophylactic neck dissection is the inability to tell which growths will metastasize only to the lymph nodes. However it is well known that a gland dissection done before gross involvement occurs gives the patient a much better chance than one done after involvement is demonstrable clinically. Therefore if the primary lesion is located so that its lymph drainage is fairly well predictable a prophylactic dissection should be done (Fig. 4)

#### REPORTS OF ILLUSTRATIVE PATIENTS

The following brief case reports are included to show a few worthwhile results of endeavor and to recall some vagaries of the lesion.

**CASE 1.** Seven year cure following radical neck dissection of metastatic melanocarcinoma. The



Fig. 10. Melanocarcinoma of buccal mucosa in negro with metastases to the cervical glands and lungs. Courtesy of Dr. H. A. Baxter, Montreal, Quebec.

patient also in Figure 4 had mole removed (elsewhere) from the right temple, thus recurring in 3 years and was removed again. Three years later lump appeared under the angle of the jaw. When seen at that time, biopsy showed metastatic melanocarcinoma and an extremely radical neck dissection was done. Within 6 months there are many metastatic areas along the upper incision area as widely excised. Patient has remained 11 7 years with no evidence of local or distant recurrence.

**CASE 2.** Patient with primary melanoma of parotid and secondary skin metastases, alive and well 4 years after radical removal. A 45 year old woman had parotid tumor removed elsewhere and 6 months later there was a recurrence in the gland with subsequent appearance of black area behind the ear. When seen 6 months later, complete removal of the tumor as done about sacrificing the seventh nerve plus removal of the involved skin. This patient is alive 4 years without evidence of recurrence but should have complete neck dissection done. The seventh nerve was saved because it was not felt that there was enough invasion to necessitate its removal.

**CASE 3.** Patient well 35 years following removal of metastatic melanocarcinoma. The patient also in Figure 3a shows mass (the neck) and the scar of removal (done elsewhere) of a black mole from the lobe of the ear. 35 years previously. A thorough but somewhat limited dissection of the area was done and he died 35 years with no sign of recurrence, when he died accidentally. He should have had complete neck dissection done.

**CASE 4.** Mole on chin removed third and cancer past neck metastasis. Figure 4a shows healed primary area on chin with large cervical metastases present 6 months. The dissected mass and the later appearance is seen. Figure 4b and Patient died 32 years after operation from metastases in lower neck, which was not dissected because of refusal by patient.

**CASE 5.** Melanocarcinoma mole of the cheek neck metastases. Figure 5a shows mole in man of 4 years that had developed 5 years before it



Fig 11 a, Illustration of an ugly, slowly growing mole of the lip b, The site of the mole after cautery removal

c, The final healing result with the practically invisible scar

had grown and become blacker in the past 2 months, and one node under the jaw was enlarged. Figure 5b shows scar of removal and the grafting of the original area after radical neck dissection when gross involvement was found. One year after neck dissection a mass appeared in the parotid gland of the same side. This was removed, but the seventh nerve was saved. The growth was found to be melanomatous. No other recurrences 15 months later.

CASE 6 Primary parotid melanocarcinoma with seventh nerve paralysis. The patient shown in Figure 6 gave some difficulty in diagnosis because the growth was thought to be a malignant mixed tumor of the parotid. At operation, when it was found to be coal-black, it was thought at first to be from coal tar, as he was known to have constantly chewed tar on this side of the mouth. Extremely radical operation was done but death resulted in a few months, presumably from distant metastases.

CASE 7 Melanocarcinoma of the scalp without gland involvement but with death from metastasis to the stomach. Figure 7 shows the primary scalp growth that was irritated in combing the hair. It was treated (elsewhere) with the "electric needle" and lanced twice. The area was widely excised and grafted. Four months later death occurred and he was found to have melanocarcinoma around the pylorus. No local recurrence or cervical gland involvement was present.

CASE 8 Melanocarcinoma with skin, gland, and pulmonary metastases. Figure 8 shows, rather poorly, the multiple metastases following chemical irritation and growth of a mole in the temple. A problem of some academic interest even though it is of little logic, was involved in the treatment carried out in this patient, namely, since this patient was slowly developing melanotic areas over his whole body, it was conjectured that vitiligo might be in opposite condition. Therefore as a

negro was present who had become practically white over a period of years, some of his blood and parts of his skin were put under the skin of this patient. The disease progressed, however, and pulmonary death occurred 1 year later.

CASE 9 Melanocarcinoma of foot, local and inguinal region control of growth, with death from abdominal metastasis. The patient in Figure 9 is included in this group as a matter of interest. The rather small original lesion was controlled by removal and grafting, inguinal involvement was removed with no recurrence following, but the patient died after 16 months with abdominal metastasis. This growth had developed in an occupational callus which had ulcerated and became granulomatous in appearance over a period of 6 months.

CASE 10 Melanocarcinoma in arm, removed and grafted. Death  $4\frac{3}{4}$  years later with metastasis in brain but with no local recurrence. A melanocarcinoma occurred in a developmental mole of 7 years' duration in a woman of 36. Wide excision and grafting was done. Nearly 5 years later she developed a metastatic gland above the opposite clavicle and soon died with a cerebral involvement. There never was any local recurrence or evidence of axillary metastases on the same side.

CASE 11 Occurrence of melanocarcinoma and adenocarcinoma of sigmoid in one patient. A 40 year old man had a reddened area on his leg 11 years previously. Four years later it was traumatized and ulcerated. Three years later a melanocarcinoma was evident and it was removed. Four years later the local area was well but melanocarcinoma was dissected from the inguinal region. Four months after this there was intestinal obstruction necessitating a colostomy, and another malignancy was found to be present, an adenocarcinoma of the sigmoid. Death occurred 3 months later with no evidence of the melanocarcinoma.



# THE PATHOLOGICAL PHYSIOLOGY OF JOINTS

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AS early as 1742 William Hunter discussed the structure and diseases of the articulating cartilage. In 1794 Edward Ford set down his observations on joint affections. Percivall Pott's teachings were compiled in 1808. Brodie in 1834 and Barwell in 1881 devoted comprehensive volumes to the pathology and surgery of joint diseases, and in 1879 Henry Morris wrote an excellent book on the anatomy of the human joints. In recent years, Nichols and Richardson, Leriche and Pollicard, Knaggs, Phemister, Fisher, Sigurdson, Pemberton, Key, King, and many others have made definite contributions. There are as yet numerous unsolved problems concerning the diseases of the joint. But there is a great deal known and the persistent disregard as to what makes up a joint has clouded our understanding of what goes on within it, in health or disease.

## THE ORIGIN AND CLASSIFICATION OF JOINTS

All the intrinsic elements of the joint except the nerve fibers and the nucleus pulposus of the intervertebral fibrocartilage arise from mesoderm. In the region of the future skeleton, the mesoderm undergoes circumscribed condensations which are later transformed into cartilage and bone. The joints are formed from the embryonic connective tissue blending these segments. The fate of this interposed tissue determines the type of joint that is developed later.

In synarthroses the embryonic tissue uniting the skeletal anlage remains a continuous substance though it may differentiate into a thin membrane, a ligament, or a cartilaginous plate. Respectively the joint is called sutura, syndesmosis and synchondrosis. The union between the bodies of the vertebrae presents a modified form of synchondrosis in that the intervening tissue is fibrocartilage and con-

tains the remnant of notochord nucleus pulposus, which provides the joint with a springy resilient motion. For this reason, the articulation between the bodies of vertebrae is called amphiarthrosis (12) meaning a joint with slight motion, as synarthrosis represents joints with no motion and diarthrosis is the term applied to joints with free, or relatively free motion.

In diarthroses the embryonic tissue uniting the skeletal parts does not remain uninterrupted. It splits, giving rise to a space. The formation of the cavity begins at the sides and extends toward the center of the joint between the ends of future bones and for a variable distance around them (3). Several clefts thus formed converge into a continuous cavity. Prior to this, the condensed mesodermal forerunner of future bones undergoes changes preliminary to ossification. In the center of what later becomes the shaft of the bone the dense mesodermal tissue turns into cartilage and then into bone. The extremities, the future articular ends, though as yet cartilaginous, expand and assume definite forms. The configuration of the articular ends of bones and the manner in which the apposing joint surfaces are reciprocally shaped and received determines the variety of diarthroses produced as well as the extent of motion permitted.

## THE GENERAL ANATOMY AND THE PATHOLOGICAL PHYSIOLOGY OF DIARTHROSES

Save for the temporary synchondroses uniting the epiphyses and diaphyses of long bones and the articulation between the bodies of vertebrae the pathological liability of synarthroses is practically nil. On the other hand diarthroses are prone to a wide range of disturbances. As a matter of fact when we speak of joints, we tacitly refer to diarthroses and hardly think of synarthroses. Because of their mobility their comparatively complex mechanics, and the fact that they are composed of several highly differentiated struc-

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tures, such as the articular cartilage or the synovial membrane, diarthroses are subject to a great variety of derangements

#### THE COMPONENTS OF THE JOINTS

A diarthrosis consists of a cavity surrounded by synovial membrane and articular cartilage which are supported by the fibrous capsule and the articular ends of bones, respectively. Except perhaps early in disease none of the constituents of the joint is involved to the exclusion of others. But the behavior of various components is singular and the complex phenomenon of joint disease can perhaps be understood better by a consideration of each and every element singly.

*The articular cavity* The space contained in a joint can hardly be regarded as one of its components. Yet the articular cavity is a characteristic feature of diarthroses. Upon its integrity depends the function of the joint, as movements are compromised when the joint space is invaded by adhesions and exudates, or when it is encroached upon by overgrowths from the surrounding tissues.

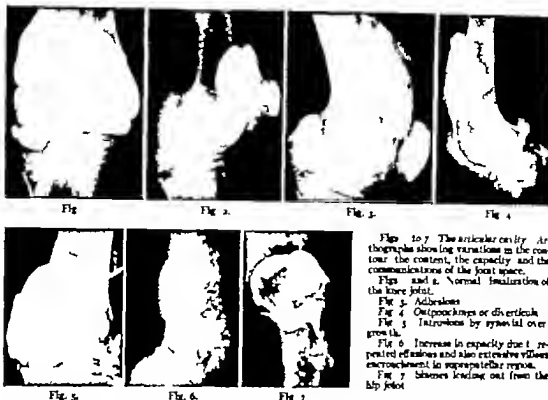
The articular cavity is bounded by the synovial component of the joint capsule and by the cartilage covering the ends of bones. The cavity is variable in extent, in some joints, such as the sacro-iliac, it is almost non-existent, in others, the knee for instance, it is large. The capacity of a given joint cavity varies with disease and, to some extent, with age. The cavity may be completely obliterated, or it may be broken up into smaller spaces by adhesions. Due to the extensibility of the joint capsule, after repeated effusions the cavity may attain great dimensions. There is normally a partial intra-articular vacuum and joints are under negative pressure. When the joint is filled with fluid, the tension within the cavity becomes positive and may reach as high a level as 700 millimeters of water (32).

Bursæ in the vicinity of the joint may connect with the articular space, and adventitious communications may be established incidental to intra-articular fractures, dislocations with capsular tear, in osteomyelitis complicating the joint, and when pus breaks into or out from the joint cavity. Normally, however,

the joint cavity, as visualized by a radio-opaque substance, casts a confined shadow that has a smooth, unbroken contour. When there are adhesions between the apposing surfaces, the contour of the cavity, similarly visualized, will be jagged and irregular. With the same technique, pedunculated fat pads and hypertrophied villi bulging into the joint space, sinuses leading into and out from the joint, and other variations in the content, capacity, and the contour of the articular cavity may be demonstrated (Figs 1 to 7).

*The articular cartilage* On the side toward the articular ends of bones, the joint cavity is bounded by hyaline cartilage. The cartilage covers the ends of the bones, toward the cavity it presents a smooth, glistening surface. The cartilage is essential for the maintenance of joint space and the gliding, insensible execution of movements. Being somewhat elastic, it serves as a resilient cushion, absorbs shock, disseminates stress and strain, and protects the underlying bone from pressure. Structurally (13) the cartilage consists of hyaline matrix and cells which are enclosed in lacunæ. The cells nearer the joint cavity are flattened in a plane parallel with the surface, those in the intermediary zone are disposed irregularly, and the deep cells are arranged vertically. The interstitial substance is considered a product of the cells and the capsule around the cells is interpreted as the matrix most recently laid down. Notwithstanding its homogeneous appearance, hyaline matrix contains collagenous fibrils which are arranged with adaptation to the mechanical needs of the cartilage. On the side where the cartilage is bounded by bone, the matrix is infiltrated with calcium salts, and the line of demarcation between cartilage and bone is relatively sharp (Fig 8).

The articular cartilage has no nerves, lymphatics, or blood vessels of its own. Pain is incited indirectly by pressure upon the sensory endings in the underlying bone, or within the surrounding capsule. Nourishing fluids reach the interior of the cartilage by transference through the bloodless matrix. Three sources of nutrient supply have been suggested: the synovial fluid (25), the blood vessels of subchondral bone (35), and the



Figs. 1 to 7. The articular cavity. Arthrograms showing variations in the contour, the content, the capacity and the communications of the joint space.

Figs. 1 and 2. Normal fixation of the knee joint.

Fig. 3. Abrasions.

Fig. 4. Outpocketings or diverticula.

Fig. 5. Intrusions by synovial overgrowth.

Fig. 6. Increase in capacity due to repeated effusions and also extensive villous encroachment in suprapatellar region.

Fig. 7. Bursae leading out from the hip joint.

rich network of "circulus articularis vasculosus" (15) of the joint capsule. It is said that the superficial stratum of the central articular cartilage thrives upon the synovial fluid; its deeper zone depends upon the lymph exuded by the vessels of subchondral bone and the marginal cartilage derives its nourishment from the "circulus articularis vasculosus" (6).

Elsewhere in the body, in the ventral ends of ribs for instance, hyaline cartilage is invested with a connective tissue coating known as perichondrium which contains chondrogenic cells. After birth, the articular cartilage is bare over its greater central surface and only a narrow slip of the synovial membrane strays over its rim. This marginal covering is said to possess chondrogenic powers (6). The proximity of the rich network of capsular vessels further enhances the regenerative chances of the marginal cartilage while the central portion has little or no power of regeneration. This does not mean that its wounds do not ever heal. Defects of the central cartilage may

be effaced by connective tissue growing from the synovial membrane and from the subchondral marrow spaces; mature cartilage cells may revert toward their precursors, the fibroblasts, and lay down new connective tissue. The latter process is extremely slow and cannot be depended upon. Superficial abrasions of the central articular cartilage may take a long time to heal or remain unhealed indefinitely while a deeper gash, which communicates with the cancellous spaces, is soon spanned by the vascular connective tissue of the marrow. Marrow connective tissue is inactive in instances where the articular end of the bone has already undergone necrosis due to vascular interruption, such as occurs in some cases of complete intracapsular fracture of the femoral neck (33).

On the whole, the articular cartilage is relatively inert and plays a passive rôle in disease (34). It is affected by circulatory changes which curtail its nutrient supply; it is eroded and undermined by tufts of connective



Fig 8



Fig 9

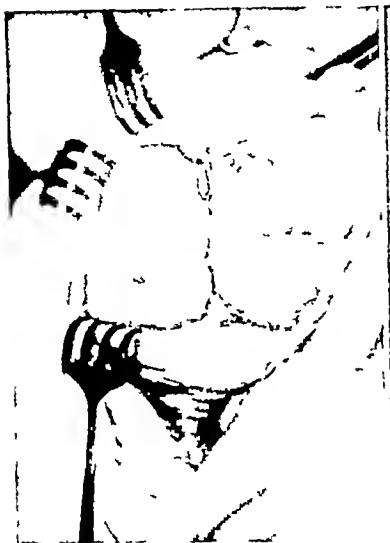


Fig 10

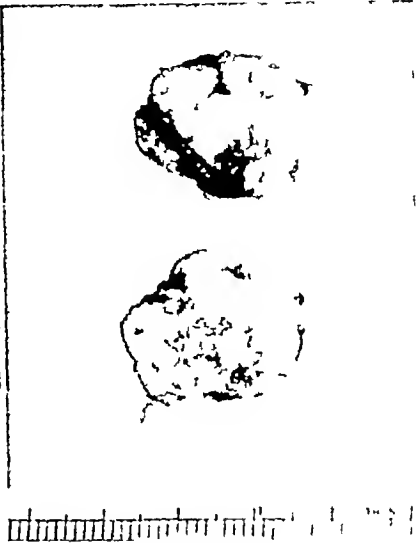


Fig 11

Figs 8 to 11 The articular cartilage

Fig 8 Photomicrograph of the distal articular end of the metatarsal bone showing the normal relation of the articular cartilage to the subchondral bone and the marginal wedge of synovial membrane

Fig 9 Section through a marginal "spur"

Fig 10 Photograph of the knee at the time of the arthrotomy showing the ulceration of the central articular cartilage of the medial femoral condyle and of the everted patella

Fig 11 Resected metatarsal heads from a case of bilateral hallux valgus demonstrating the erosion of the articular cartilage when forced to function in a mechanically disadvantageous position

tissue growing from inflamed synovial membrane, it is lifted and loosened by subchondral granulations sprouting from the marrow spaces, it cracks and collapses when its bony support breaks down. Trauma, and trauma alone, may be regarded as the primary affection of the articular cartilage. Trauma may be acute or chronic. Contusions of the articular

cartilage may heal without symptoms, or the abraded region may manifest surface fibrillation and death of the cells around the contused area (16). A piece of cartilage may break loose into the joint. When both cartilage and bone are free in the joint cavity, the cartilage cells retain their vitality whereas the majority of bone cells die (6). By virtue of the nourish-



Fig. 1.



Fig. 2.



Fig. 3.



Fig. 4.

Figs. 1-3 The articular ends of bones, necrosis due to infection.

Fig. 2 Tuberculous destruction of the shoulder. Note the dense sequestrum, the invasion of metaphysis of the humerus, and the radio-opaque exudate.

Fig. 3 Tertiary syphilitic destruction of the shoulder.

Fig. 4 Kissing sequestra of the hip. Note the oval focus in the neck of the femur.

Fig. 5 Diffuse pyogenic destruction of both acetabular and femoral articular surfaces. Note that the destruction present is most extensive at the points of contact and pressure.

ment they obtain from the synovial fluid, the cartilage cells may proliferate and cover their core of dead bone completely, or the broken piece may gain attachment to the synovial membrane and derive additional nourishment through a vascularized pedicle.

Instances of chronic trauma to the articular cartilage are seen when a normal joint is subjected to repeated injuries from incongruity of articular surfaces, from overuse, and from abnormal function. The cartilage wears down at points of contact and pressure. It loses its surface gloss, its resilient hardness, becomes soft felt-like velvety. The layer of cartilage nearest the joint cavity slowly disappears and the main body of deeper cartilage splits perpendicularly to the surface. The zone of provisional calcification cracks, the unprotected subchondral bone is exposed and it wears smooth by usage. The cartilage in the vicinity of the denuded area, especially in the marginal portion undergoes compensatory hypertrophy and proliferation. Proliferating cells are usually arranged in clumps and lead to thickening of the involved areas. When these areas enlarge and visibly bulge out, they are called *ecchondroses*. The distinction is made between the commoner marginal *ecchondroses* and the less frequent nodules beneath the articular surface which are called *eparticular ecchondroses*. Eparticular swellings tend to produce incongruities of the joint

surfaces; marginal growths widen the surface. *Ecchondroses* may become colonized by the blood vessels and receive an *osseous core*; then they are called *chondro-osteophytes*. When ossification is complete they are given the name *osteophytes*. *Ecchondroses*, *chondro-osteophytes*, or *osteophytes* may become detached and when they are free in the joint cavity they are called *osteoarticular loose bodies* (Figs. 9 and 10).

The articular cartilage is also affected by physiological discrepancies. In amputations through the joint the cartilage at the end of the stump subsequently undergoes connective tissue dedifferentiation. In long standing, unreduced dislocations, the cartilage often passes through a similar regressive change. In an experimentally planned operation when the joint cartilage is forced to function against a tendon (37) rather than cartilage it wears down and degenerates (Fig. 11). Thus the articular cartilage needs healthy cartilage on the apposed surface to live, and though lack of motion does not in itself cause an undamaged cartilage to die, in prolonged immobilizations the synovial fluid is scant and being thus deprived of one of its sources of nourishment the cartilage may degenerate.

The chain of events initiated by erosion and necrosis of a portion of the cartilage with compensatory overgrowths of other areas has been variously called *degenerative hypertrophic*



Fig 16

Fig 17

Figs 16 to 20 The articular ends of bones, epiphysiolysis due to infection

Fig 16 The slipped epiphysis as the result of pyogenic destruction of the femoral neck

Fig 17 The same as Figure 16, 6 weeks later With traction the shaft of the femur has been pulled down Note the relative density of the dead femoral head and the shelf of osteophyte growing from the upper acetabular margin

Fig 18 The sequestered epiphysis which was removed surgically, photograph showing the greater destruction of the articular surface at points of contact and pressure

Fig 19 Photograph of sagittally sliced surface

Fig 20 Same as Figure 19 Photomicrograph of section showing the excavation into the interior of the epiphysis and the extensive necrosis of trabeculae



Fig 18

Fig 19



Fig 20

or osteoarthritis It has experimentally been shown that if a portion of the articular cartilage is injured, removed, or the mechanics of the joint are so altered that function will damage the articular cartilage by incurring repeated trauma, pathological changes characteristic of degenerative arthritis develop when the animal continues to use the injured joint, and such changes do not develop when the joint is immobilized (17)

*The articular ends of bones* The supportive framework of joints consists of reciprocally shaped and received ends of two or more bones The articular ends are composed of cancellous interior and a thin coating of compact bone The latter is known as the articular lamella, or cortex, and forms the joint surface of the bone It has no haversian canals, no canaliculi, nor is it penetrated by blood vessels (12) Therefore, it is denser and harder than ordinary compact bone and serves as an unyielding support to the articular cartilage The cancellous interior of the articular ends contains numerous intercommunicating spaces which are filled with marrow and are bounded by anastomosing trabeculae The arrangement of the trabeculae is such that maximum strength is secured with minimum

material where stress is great the trabeculae are thicker and more closely welded, in regions of light stress, the trabeculae are thin and widely spaced The trabeculae are invested by a thin layer of connective tissue, the endosteum, which contains bone-forming and bone-destroying cells The endosteum is so intimately related to the stroma of the marrow that the 2 are regarded as identical by some (5) and are spoken of as the connective tissue elements of the cancellous spaces or of the marrow There are nerves, lymphatics, arteries, and veins in the marrow and, in addition, marrow contains numerous thin walled capillaries known as sinusoids (23) These are not lined with endothelium but with the flattened cells of marrow stroma, the circulating blood is thus brought into close relation with the supportive and cellular elements of the marrow The cells of the marrow can pour into the blood stream with phenomenal rapidity, and foreign particles floating in the blood easily penetrate the thin walls of the sinusoids and find their way into the marrow tissue

The articular ends of bones are thus composed of osseous elements on the one hand and



Fig. 1

Fig. 2

Fig. 3



Fig. 4

Fig. 5

Figs. 1 to 3. The articular end of bones, aseptic necrosis.

Fig. 4. Dead head incidental to intracapsular fracture of femoral neck.

Fig. 5. Sequestered head following aseptic epiphysiolysis. Note that the nasal and inferior portion of the dead head is undergoing creeping replacement, probably by the connective tissue elements of the round ligament.

Fig. 6. Metastrophosis and crumbling of the femoral head into numerous sequestrous bodies. This patient "limped" at about the age of 10. The question of an old Pott's disease is considered.

Fig. 7. Necrosis of carpal lunette (Kienboeck's disease). Note the area of rarefaction. While the articular end of the radius opposes the dead bone. This is not unlike the osteoporotic areas one sees in degenerative arthritis.

Fig. 8. Necrosis and collapse of the left tarsal navicular (Kocher's disease). Compare it with the navicular on the right side.

vascular connective tissue on the other. Inflammatory reactions start in the marrow within the cancellous spaces, and involve the bone secondarily. When its blood supply is cut off as by the pressure of pent up pus, edema or intravascular occlusion, the bone dies. Proteolytic ferments in the exudate and perhaps the activated osteoclasts of the endosteum enhance bone necrosis; vascular granulations originating from the marrow absorb the dead bone at its periphery and separate it from the living (28). The calcium content of the dead bone remains unchanged but if the necrotic fragment is small, it can be completely digested leaving instead a cavity.

The broken down trabeculae further liberate marrow connective tissue granulations work their way toward the joint or into the periphery. When the articular cortex is eroded the overlying cartilage detaches and dies. The joint is now invaded by exudate and granulations which attack the opposite articular surface. Denuded bones contact granulations from both sides meet unite adhesions are formed. When inorganic salts impregnate the connecting granulations, bony ankylosis is the outcome. Proliferated connective tissues which work their way peripherally toward periosteum lay the foundation for marginal spurs. The influence of the organism, the



Fig 26



Fig 27



Fig 28



Fig 29



Fig 30



Fig 31

Figs 26 to 30 The articular ends of bones, incongruity arising from miscellaneous causes

Fig 26 Pyogenic invasion of upper tibial epiphysis with collapse of the medial articular cortex

Fig 27 Partial arrest of epiphyseal growth resulting in tilting of the tibial plateau and knock knee

Fig 28 Unevenness of tibial surface due to malunited, depressed fracture of lateral tibial condyle

Fig 29 Old united intracapsular fracture of femoral neck Note the collapse of the articular cortex due to weight bearing before the dead femoral head had been completely replaced and organized

Fig 30 Incongruity resulting from lack of appositional remodeling of the acetabulum and femoral head in congenital dislocation of the hip

Fig 31 The articular ends of bones Tumor of the distal tibial articular end at the ankle joint Biopsy was reported as "spindle cell" sarcoma and it was thought to be a malignant change coming on in a previous giant cell tumor Note the comparatively intact articular cortex

character of the exudate it incites, and mechanical factors of contact and pressure within the invaded joint variously modify the picture (Figs 12 to 15)

Articular ends may break down due to aseptic necrosis This may result from in-

juries, vascular blockage, overexposure to radium or x-ray, and by the nitrogen gas of caisson disease There are a number of related conditions—as Perthes' disease of the hip, Koehler's of the tarsal navicular, and many others—in which areas of necrosis of the





Fig. 32.



Fig. 33.

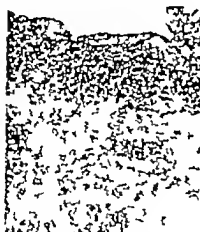


Fig. 34.



Fig. 35.

Figs. 32 to 35. The synovial membrane.

Fig. 32. Photograph of surgically opened knee joint of young girl suffering from proliferative arthritis. Note the synovial pusness invading the articular surfaces of both femoral condyles—especially the external—and the pearly egg shaped loose body beneath the medial condyle.

Fig. 33. Same as Figure 32 showing the erosion of the articular cartilage underneath the synovial pusness which is aged by.

Fig. 34. Section through thickened membrane demonstrating agglomeration of round cells underneath the synovial surface and around the blood vessels.

Fig. 35. Photomicrograph of section from another case showing the enlarged dilated

growing bone lead to eventual malformation of the articular ends. In certain joints, such as the hip, the plate of cartilage connecting the epiphysis and diaphysis lies within the capsule. Disturbances of this cartilage may lead to slipping of the articular end with consequent malalignment with the shaft. In

pyogenic arthritis the epiphysis is sometimes completely cut off from its main blood supply and dies (Figs. 6 to 20). The same holds true in a certain percentage of intracapsular fractures of the femoral neck (29). Vascularized connective tissue may invade the lead head by way of the round ligament through

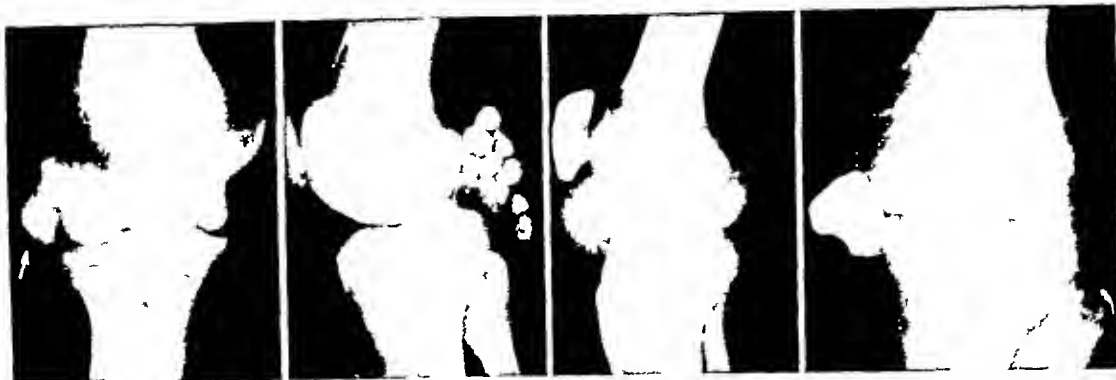


Fig 36

Fig 37

Fig 38

Fig 39

Figs 36 to 40 The synovial membrane

Fig 36 The opaque oval mass in the lateral aspect of the elbow was thought to be calcification within the radio-humeral bursa. On biopsy it was found to be a nodular thickening within the synovial wall which consisted of strands of collagenous fibers and connective tissue cells.

Fig 37 Osteocartilaginous bodies which were presumed to originate from the synovial membrane since the skeletal articular surfaces of the knee are smooth and unbroken.

Fig 38 Calcification within the synovial wall, in the infrapatellar fat pad.

Fig 39 Synovial cyst visualized by injection of iodized oil.

Fig 40 The surgically removed specimen of the same together with the medial semilunar cartilage.



Fig 40

untorn portions of the capsule, or through attachments formed between the two articular surfaces. The invading connective tissue replaces the dead marrow and bone and may eventually organize into new bone by metaplasia, which takes an appreciable time to complete itself. When weight is borne upon a dead or incompletely substituted articular end, its cortex collapses, the overlying cartilage caves in, and the joint surface becomes irregular, uneven. Incongruities of the articular surfaces also arise from unreduced or improperly reduced fractures into the joint (Figs 21 to 29).

Articular ends are capable of functional adaptation. Alterations in the mechanics of the joint are reflected by changes in the internal architecture as well as in the external configuration of the bone. At points of excessive pressure the trabeculae thicken and increase their lime content, where no weight is borne, or stress due to motion is eliminated, the trabeculae thin and rarefy. Lack of appositional stimulation retards the development of both femoral head and acetabulum in con-

genital dislocation of the hip (Fig 30). The acetabulum remains shallow, the small femoral head may undergo such adaptive changes when forced to function in abnormal situations for a long time that, even when put into a deepened acetabulum, its shape and alignment with the shaft may be incompatible with normal hip function. (2) Tumors of the articular ends of bone may eventually break into the joint though the cartilage is very resistant to such invasions (Fig 31).

*The joint capsule* The sleeve of connective tissue which envelopes the joint cavity and binds the skeletal parts together consists of an outer coating known as the fibrous capsule and an inner lining, the synovial membrane. The fibrous capsule is irregularly reinforced by thick bands and is supported by tendons, muscles, and ligaments. In its turn it supports the synovial membrane. In some joints the fibrous capsule is incomplete and the synovial membrane rests on fat and areolar tissue, muscles, and periosteum. In the same joint, there are areas in which the fibrous capsule and the synovial membrane are inseparably

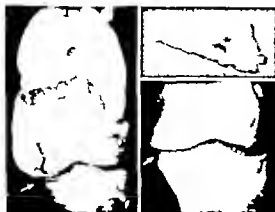


Fig. 41

Figs. 42 and 43

Figs. 41-43. Fibrocartilages.

Fig. 41. Arthrography of the knee. Note the shining line passing through tear at the chondrosynovial junction of the medial meniscus.

Fig. 42. A sclerolization of osseous, chronically injured semilunar cartilage.

Fig. 43. Calcification of medial meniscus of the knee.

fused at other points, the interposition of fat and areolar tissue makes it possible for the synovial lining to be lifted as a separate layer.

**Fibrous component.** The fibrous capsule connects the articular ends of bones, restricts motion, and helps to stabilize the joint. Severe trauma may rupture the capsule and, unless the torn edges are carefully apposed and held together, there remains a gap through which the synovial membrane may herniate. A similar situation obtains in the aged and arthritics in whom the synovial membrane bulges through worn-out areas as does an inner tube through the frayed spots of an old casing. After repeated effusions, or incidental to chronic strain due to over weight, in dislocations and paralytic subluxations the capsule becomes lax. Conversely it may undergo contractures secondary to inflammatory diseases of the joint, to malformations, to burns and cellulitis, or to upper motor neuron lesions. Lastly the fibrous capsule may form tumors.

**The synovial membrane.** The synovial membrane lines the articular aspect of the joint capsule. Toward the joint cavity it presents a pale-gray moist glistening surface which bears a superficial resemblance to serous linings but there the resemblance ends. Serous

membranes line the primary cavities that originate from the coelom early in embryonic life. Joints are developed later from mesoderm. Serous membranes are lined by a regularly patterned layer of cells, the endothelium, the cells of the synovial membrane may lie on the surface but do not line it in any orderly fashion. Serous surfaces appear smooth and are smooth. Synovial surfaces may appear smooth but closer observation will reveal tags, villi, and pleats. Finally synovial membranes differ from serous coatings by their relative thickness, their richness of blood vessels and their slimy secretion, which makes them functionally akin to mucous membranes. Structurally synovial membranes have nothing more in common with mucous linings than they have with serous coatings.

The synovial membrane is a modified connective tissue lining a connective tissue space, the joint cavity. It is attached around the margins of the articular cartilage from the edges of which it sweeps over the cartilage bare intra articular ends of bones. It is then reflected to line the fibrous capsule. Tendons and ligaments within the joint are invested by the synovial membrane and cartilages receive a slip of marginal coating from it. In adaptation to the mechanical conditions to which the surface of a given area is subjected the synovial membrane presents a



Fig. 44

Fig. 45

Figs. 44 and 45. Ligaments.

Fig. 44. Calcification of previously injured collateral ligament of the knee (Pellegrini Stieda's disease).

Fig. 45. Freshly torn fibular collateral ligament causing lateral instability of the knee.

variable structure (18) Areolar synovial membrane lines those parts of the joint where movement of the surface over the underlying tissue is needed, the fibrous type covers the areas which are subjected to pressure or strain as over intra-articular ligaments and tendons, the adipose variety invests the fat pads which project into the joint cavity From within outwards, the membrane consists of two strata (6, 31) an internal and an external The internal is compact, cellular, and, on the whole, relatively avascular, the external is richly vascular and, save in the fibrous type of synovial membrane, it is loosely constructed and contains a variable amount of fat cells and areolar spaces Of special interest is the area of transition between the synovial membrane and the articular cartilages As the cartilage is approached the synovial membrane splits into a wedge, the base of which roughly corresponds to the margin of the cartilage (Fig 8), the surface cells flatten and gather into groups simulating cartilage cells in lacunæ, as such a strip of synovial membrane strays over the rim of the cartilage Within the folds of the synovial wedge, around the circumference of the cartilage, is the rich network of capsular vessels Somewhat more peripheral, stemming from the synovial membrane proper, are the villi, pleats, and fringes, which are pedicled projections of the membrane they produce a tremendous increase in the absorptive surface of the joint capsule (22) Besides blood vessels, synovial membranes contain nerve endings

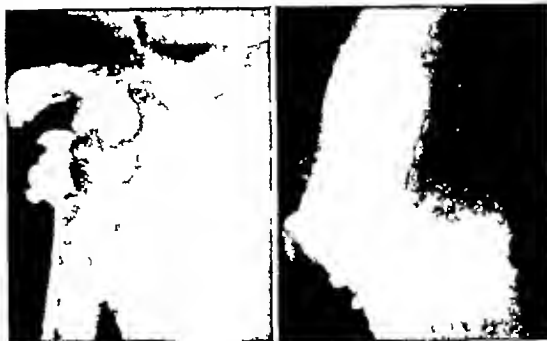


Fig 48

Fig 49

Figs 48 and 49 Bursæ

Fig 48 Visualization of the subacromial and subdeltoid bursæ

Fig 49 Arthrography demonstrating the continuity of the popliteal bursa with the cavity of the knee

and lymphatics The blood vessels do not lie bare on the surface of the synovial membrane a few cells or a strand of collagenous fibers separate them from the joint cavity

The function of the synovial membrane is to provide the joint with a smooth, flexible surface, it is in part responsible for the production of synovial fluid Though well substantiated proofs are as yet wanting, it is generally conceded that the synovial membrane plays an important, perhaps active, rôle, in the exchange of material between the joint cavity and the circulation Crystalloids are quickly removed from the articular cavity, suspensions of fine colloids diffuse through the synovial membrane into the subsynovial tissue and thence into the blood stream and lymphatics, a coarse colloid is removed from the joint with more difficulty (19) Gross particles like a fragment of bone may become surrounded by the synovial membrane in a fold of adhesion or gain an attachment to its inner aspect and acquire a crust of new cartilage covering its raw surfaces The membrane can itself produce osteocartilaginous loose bodies The synovial membrane regenerates when dissected away (20)

Structurally, functionally, and pathologically, the internal stratum of the synovial membrane has been regarded as analogous to the articular cartilage, while the external layer is considered akin to the cancellous spaces of the articular ends of bones (31)



Fig 46

Fig 47

Figs 46 and 47 Muscles and tendons

Fig 46 Posttraumatic myositis ossificans about the elbow incident to dislocation

Fig 47 Calcification of supraspinatus tendon



Fig. 50.



Fig. 51



Fig. 52.



Fig. 53



Fig. 54

Figs. 50 to 54. Neurogenic joint disturbances.  
Figs. 50, 51, 52, and 54. Tabetic arthropathies of the hip, knee, ankle, and of the big toe. Note the sequestra.

tion of the femoral head shown clearly in Figure 50.

Fig. 53. Dislocation of the hip due to anterior poliomyelitis.

Together with the cartilage the internal stratum provides the joint with a gliding surface and preserves the integrity of the cavity like the articular cartilage, in disease it plays a comparatively passive rôle. On the other hand the loosely constructed and richly vascular external stratum becomes the active arena of inflammatory changes: hyperemia, edema, cellular infiltration and tissue proliferation. From the loose areolar spaces of the external layer tissue fluids pass into the joint cavity giving rise to hyarthrosis, which lasts as long as hyperemia persists. If irritation continues prolonged congestion of the external layer leads to cellular infiltration and tissue proliferation. Finger-like processes of proliferated connective tissue indent the internal stratum and project into the articular cavity creating a phase of joint inflammation known as chronic villous synovitis. Pannus is a connective tissue column which has crept over the articular cartilage, has adhered to its surface. Vascular granulations invading the

joint cavity attack and erode the articular cartilage and establish adhesions between the joint surfaces. Usually proliferative activity is going on in the marrow connective tissue at the same time and the articular cartilage may be attacked from below as well as from its margins. When the articular cartilages are completely eaten away the granulations coalesce to form adhesions with subsequent ossification of these connecting strands, bony ankylosis is the outcome. The slow culmination of these events, because of superficial clinical resemblance to rheumatic fever has been given the name rheumatoid arthritis (8) frequent, though by no means exclusive association of the joint lesion with foci of non-specific infections has given others cause to coin the term infectious arthritis, and when such foci are not manifest, the adjective atrophic is substituted since on opening the joint, the cartilage is seen frayed and x-ray films show the bones to be porotic (11) however proliferation of marrow and synovial



Fig 55



Fig 56

Figs 55 and 56 Circulatory relations

Fig 55 Immediate lymphatic drainage from the knee Note the popliteal node and the efferent and afferent tracts

Fig 56 The swollen, stiff knees of a patient suffering from thrombo angitis obliterans

connective tissue is regarded as the basic pathological feature, and proliferative arthritis is a term preferred by some (24) (Figs 32 to 35)

The internal stratum of the synovial membrane, though permeable to tissue fluids, at first resists the infiltration of cellular elements within the external layer (31). In time, however, with persisting edema and congestion of the external stratum, this barrier is broken, and exudate pours into the joint cavity. If bacteria are lacking, aseptic pyarthrosis is the result, with infection, septic pyarthrosis ensues.

Tears of the synovial membrane which involve both the internal and external strata are usually followed by hemarthrosis. Fresh blood in the joint, undiluted with synovial fluid, clots easily, but after it has been attacked by inflammatory exudate it remains liquid, though it undergoes disintegration (31). The red blood cells break up and donate their pigment to the joint fluid while the fibrin may organize into adhesions. Blood clots in the external stratum, especially in fat tissue, may calcify and even ossify.

The synovial membrane is capable of producing new-growths. Reference has already

been made to the production of synovial chondromas. Synovial cysts are areas of mucoid degeneration within the membrane. The synovial membrane may form xanthomatous growths. "Synovioma" is a term limited to tumors arising from the "lining mesothelium" (4), which probably refers to the internal stratum of the synovial membrane (Figs 36 to 40).

*Synovial fluid* The origin of the small amount of watery, viscid liquid normally contained in the joint cavity is not as yet definitely established. Accepted opinion leans toward regarding this fluid as partly a secretion by the "special" cells of the synovial membrane and in part a transudate from the circulation (22). The fluid is alkaline in reaction and contains small amounts of mucin, albumin and extractives, fat and inorganic salts (18). Pending further investigation the following characteristics, gleaned from the literature (6, 7, 21, 22) may be regarded as normal or nearly normal: specific gravity, 1.040; viscosity, 10-20°, hydrogen-ion concentration 8.2-8.4; total solids, 4.4 per cent; total protein, 1.6 per cent; mucin, 1.95 per cent; bilirubin, not exceeding 0.5 milligrams per cent; sugar, 80-120 milligrams per 100



Fig. 57

Fig. 58

Figs. 57 to 6. Mechanical disturbances.

Figs. 57 and 58. X-ray films of the knees of a man aged 18, varied between 300 and 450 pounds.

Fig. 59. Photograph of the femoral articular surface obtained at necropsy. Note the ulceration of the central articular cartilage, and marginal thickenings. Front of the joint surface is more extreme over the articular condyle since it bears the brunt of heavy weight. Note also the osteocartilaginous body ready to detach from the intercondylar fossa.

Fig. 60. The corresponding tibial surface.

Fig. 6. Photograph of the lateral view of the distal articular end of the femur showing marginal liping.



Fig. 59



Fig. 60



Fig. 6

cubic centimeters white cells 50 per cubic centimeter with a differential formula of mesothelial cells 3 per cent, granulocytes 5 per cent, macrophages 30 per cent, and monocytes 58 per cent there may be as many red cells as white. The function of the synovial fluid is threefold: it lubricates the joint surfaces and thereby facilitates motion because of its alkalinity it protects the articular cartilage against acid metabolites. It helps to nourish the articular cartilage. Motion is a physiologic stimulus for the production of a normal amount of synovial fluid.

In disease the joint fluid changes in quantity, composition, chemical and immunological reactions. The largest effusions are seen in severe inflammations and in acute disrupting trauma with hemorrhage into the joint cavity. In chronic joint diseases, the effusion is usually small. When the aspirated fluid is acid and its glucose content is down to 60 per 100 cubic centimeters or lower one suspects septic arthritis. Shift of hydrogen ion concentration toward alkalinity on repeated aspirations denotes favorable prognosis. In acute exudates from trauma or infection, the total cell count of the fluid is increased in hemarthrosis the red blood cells

predominate otherwise the cells consist of leucocytes mostly. A leucocytic count of 11,000 or more per cubic millimeter of synovial fluid which is associated with 60 per cent or more of granulocytes, in a case of chronic non-specific joint disease is likely to be accompanied by positive culture of attenuated organisms (7). The culture in septic arthritis yields ready growth of one of the following bacteria: streptococci, staphylococci, pneumococci and rarely meningococci, *Bacillus typhosus*, *Brucella melitensis*. In gonorrheal arthritis the culture may be positive and the complement fixation test of the synovial fluid may corroborate the blood findings (22). Guinea pig inoculation of the joint exudate in a case of suspected tuberculous arthritis may confirm the diagnosis. Smears of the synovial exudate are usually positive in septic arthritis at times in advanced tuberculosis and occasionally in acute gonorrhea. In syphilitic the synovial fluid gives a positive Wassermann reaction when the blood gives a positive reaction but this does not necessarily mean that the joint lesion is luetic however a positive reaction yielded by the joint fluid in the presence of a negative blood Wassermann is regarded as an evidence of syphilitic arthritis.

tis (7) In jaundice the icterus index of the synovial fluid is increased, but an icterus index of over 55 without generalized jaundice signifies a recent traumatic arthritis or subsiding hemarthrosis. The presence of fat globules in the aspirated fluid makes one suspect a tear involving the subsynovial adipose pads or intra-articular fractures putting the joint in communication with the bone marrow. An increase in cholesterol content of the joint fluid would be suggestive of xanthomatous tumor of the synovial membrane (4).

Pathological joint exudates contain ferments. They may come from bacteria, from dead tissues, or from the leucocytes. The tubercle bacillus is said to contain no proteolytic ferments, its toxins destroy the autolytic enzymes of dead tissues, the leucocytes contained in tuberculous granulations or exudate are mainly mononuclears, their ferment is active in acid media, but not in tuberculous pus, which is alkaline in reaction (26). Pyogenic exudate is acid and it contains an abundance of polymorphonuclear leucocytes which produce proteolytic ferments. Whereas the digestive action of tuberculous joint exudate is practically nil, that of pyogenic pus is marked. Proteolytic ferments assist greatly in rapid dissolution of necrotic cartilage in pyogenic arthritis, cartilage in tuberculous arthritis may persist months or years (30).

*Accessory structures* *Fibrocartilages* enter into the formation of some joints. In the hip and shoulder they are found as circumferential bands, the labrum glenoidale, which deepens the articular sockets, in the temperomandibular, sternoclavicular, acromioclavicular, and wrist joint, a biconcave plate, the articular disc, subdivides the cavity, in the knee, two crescents, the simular cartilages, protrude into the joint from the lateral and medial sides. In general the fibrocartilages obliterate the space between apposed articular surfaces, promote better reception of one articular end into the other, absorb and disperse their share of shock and pressure and in a measure modify the movements of the joint. It is possible that the interarticular fibrocartilages act as slippery fulcrums and play a rôle in the frequent dislocation of the temperomandibular, acromioclavicular and shoulder

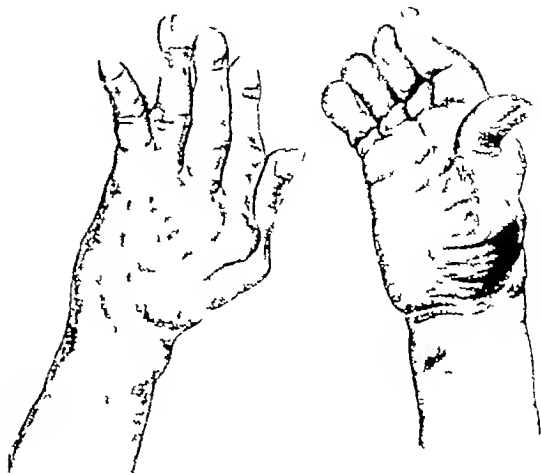


Fig 62

Fig 63

Figs 62 and 63 Primary germ cell affinity. Drawings of the hands of a man with "proliferative arthritis," subcutaneous nodules, and myocardial heart disease.

joints, perhaps it is not coincidental that gonorrheal arthritis often settles in the knees, wrists, and sternoclavicular articulations, though joints without fibrocartilages are not immune to this infection. On the whole, however, fibrocartilages in freely movable joints other than the knees are not definitely known to cause or create any disturbance. The two menisci of the knee may loosen from their moorings, become displaced, tear or split following trauma and may thus usher in a chain of events known as internal derangements. Occasionally the semilunar cartilages may undergo calcification, even ossification, at times they form cysts. Interarticular fibrocartilage lesions mechanically interfere with function of the joint and give rise to frictional erosions of articular surfaces (Figs 41 to 43).

*Ligaments* are flattened bands of white fibrous tissue which bind together the articular ends of bones and help to stabilize the joint. Distinction is made between the capsular ligament, which is another name for the fibrous component of the joint capsule, and the accessory ligaments, which aid the fibrous capsule but stand apart from it (12). Accessory ligaments may be extracapsular, such as the fibular collateral ligament of the knee, or intracapsular, as are the cruciates



Charcot joints of *tuberculous* and syringomyelia. Disturbances in the connecting and efferent links of the reflex arc cause joint lesions in their turn, as exemplified by post hemiplegic arthritis or subluxations of anterior poliomyelitis (Figs. 50 to 54)

**Circulatory relations.** Articular structures contain lymphatics and blood vessels and are nourished by them. Comparative analyses of plasma and synovial fluid indicate very close relationship between the two (27) glucose ingested by mouth will appear in the synovial fluid with surprising rapidity reaching there a concentration in excess of that of blood rise of sugar and bilirubin in the blood are followed by corresponding elevations in the synovial fluid some drugs, like sulfanilamide are recovered in the joint fluid. It is a foregone conclusion that infections and noxious metabolites circulating in the blood may affect the joint local processes in the joint may give rise to systemic reactions. Circulatory changes have their effect on joint structures hyperemia is said to cause the bones to decalcify chronic passive congestion results in hypertrophy of bone (the clubbed fingers of cardiacs) diminished circulation is followed by increased calcification when the blood supply is completely cut off the bone dies and its lime content remains static (36) The association of arteriosclerosis and osteoarthritis has long been noted and it has recently been found that a large percentage of patients suffering from rheumatoid arthritis maintain a comparatively low peripheral temperature level. It is suggested that this is due to diminished capillary flow caused by vasoconstriction. Again in this disease there is a delay in the rapidity with which glucose ingested by mouth and absorbed into the blood stream leaves the vascular channels and this delay too is ascribed to systemic vasoconstriction which is said to parallel or precede the onset of arthritis (27) Experimentally ligation of the blood vessels of the patella is followed by degeneration and hypertrophy of the articular cartilage (38) the patella itself hypertrophies (10) (Figs. 55 and 56)

**Mechanical interdependence.** Joints are functionally related to one another to the bones and to the muscles, and are influenced

by disturbances of posture and body mechanics in general. Composite movements like squatting and walking require synchronous action at several joints the hips, knees and ankles and a mechanical handicap in one necessitates adaptive changes in the others. Shift of the lines of stress and strain from the usual bearing surface of the joint to areas unaccustomed to great pressure may wear the cartilage at these points and cause the underlying bone to undergo sclerosis and the capsule or the ligaments nearby to become lax. This is often seen in the knees and ankles of the extremely obese (Figs. 57 to 61) Similar incongruities may occur when a neighboring joint becomes stiff or deformed, when there is a malunited fracture in the bones above or below the joint, in partial arrest of epiphyseal growth on either side of the joint, and in consequence of such static deformities as curvatures of the spine, tilted pelvis, coxa vara, knock knees, bow-legs, and everted or inverted feet.

**Primary germ cell affinity.** The concurrence of myocardial diseases, subcutaneous nodules, and joint affections in rheumatoid states has been ascribed to simultaneous involvement by certain strains of bacteria from a hidden focus of infection. The question still remains unsettled but one must not overlook the possibility that, with other derivatives of mesoderm joints inherit certain constitutional and endogenous peculiarities which make them susceptible to hyperergic inflammation (34) The intense inflammatory changes which follow the intra-articular injection of antigen in sensitized animals, involve the joint injected the arteries and veins about the joint and the skeletal musculature near and far from the point of injection. Repeated intra articular injections of horse serum result in deforming and ankylosing joint disease. The local hyperergic responses are associated with similar changes in other joints, in the myocardium and in large arteries (Figs. 62 and 63)

#### SUMMARY AND CORRELATION

A diarthrosis is a movable joint. It consists of the cartilage covered ends of bones and a capsul which is lined by the synovial mem-

brane It encloses a cavity and the cavity in turn contains a small amount of lubricating fluid Accessory structures further complicate the anatomy of some joints and neuromuscular, vascular, and mechanical integrations create added complexities The joint itself is formed of connective tissue derivatives and it manifests the elemental properties of its mother tissue with but slight modification In health the function of connective tissue is mechanical, in disease, it is reactive It supports and connects parts, restrains or permits motion between them When irritated, it undergoes a local adaptive change characterized by proliferation of cells immediately around the injured area and attraction of wandering cells to the region Proliferation of cells leads to granulation which, aided by the ferments of the exudate, erodes and replaces the more differentiated elements, and repair takes place by formation of scar tissue Secondary metaplasia and differentiation may then follow

Generally speaking, the more undifferentiated a tissue, the more it is apt to undergo proliferation and, conversely, the more highly differentiated a tissue the less is its capacity to proliferate, repair or reproduce itself (1) In joints relatively undifferentiated connective tissue is found in the external strata of the synovial membrane and in the marrow spaces of articular ends Differentiated elements are represented by the internal layer of the synovial membrane, the articular cartilage, the trabecula, and the cortex of the articular ends of bones, and, to a lesser extent, by the fibrous capsule and accessory ligaments Moreover, the relative vascularity of the external stratum of the synovial membrane and the marrow spaces favors localization here of circulating irritants, these two regions become the active arena of inflammatory changes The more differentiated derivatives of connective tissue—bone and cartilage in particular—passively resist inflammation, they bear the brunt of shearing and pressure stresses and break down when their elasticity is overcome Both cartilage and bone are affected by disturbances of their nutrition which hasten their disintegration Circulatory and nutritional changes may ac-

company, or result from, inflammatory processes, exudates and vascular granulations may damage the joint so as to create incongruities between apposed articular surfaces and the joint thereafter becomes liable to self-inflicted injury, in its turn, trauma affecting the skeletal elements primarily may initiate a point of irritation in the undifferentiated derivatives of connective tissue and set them toward inflammatory reactivity (Figs 64 to 67) Moreover such mechanical factors as points of contact and pressure between apposed articular surfaces may modify the course of an inflammatory process In tuberculous arthritis, for instance, the articular cartilage is destroyed first along the free surfaces where tuberculous granulations can grow and remove it, points of contact and pressure are protected from this invasion In pyogenic arthritis, on the other hand, the cartilage is killed first at the point of contact and pressure, and proteolytic enzymes derived mostly from polymorphonuclear leucocytes assist greatly in the rapid removal of necrotic cartilage (30) The organism initiating the inflammatory process and the type of exudate it incites become subsidiary factors which also influence the rate and the progress of joint destruction The irritated sensory nerve endings in joint structures may incite pain, cause reflex muscular spasm, and arrest motion, disturbances of both afferent and efferent limbs of the reflex arc, concerned with the conveyance of sensations on the one hand and motor impulses on the other, may variously result in lack of co-ordination, muscular imbalance, contractures, subluxations, and even complete breakdown of the architectural framework of the joint The function of the joint as an organ of support and passive motion is interfered with in inflammatory, mechanical, circulatory, and neuromuscular disturbances

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# CONGENITAL ATRESIA OF THE EXTRAHEPATIC BILE DUCTS

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THE fact that more than 200 cases of congenital atresia of the extrahepatic bile ducts have been reported in the literature testifies that it is not a rare disease. Nearly every pediatrician sees one or more such cases during his active career. In spite of its rather frequent occurrence, nearly everyone has entertained a pessimistic attitude toward the outcome of this malady. It required the careful studies of Holmes, Ladd, and Donovan before a note of optimism could be sounded. These workers found that from 16 to 30 per cent of all cases of congenital atresia of the bile ducts were amenable to corrective surgery, and they made several valuable contributions concerning its diagnostic and therapeutic management.

During the past 5 years we have had an opportunity to study 5 cases of congenital atresia affecting the biliary radicals and have devised a method of roentgenographically visualizing the abnormal biliary tract at the time of operation, thus giving the surgeon an accurate visual concept of the problem which confronts him.

## ETIOLOGY

Unfortunately, the pathogenicity of congenital atresia of the bile ducts is enshrouded in doubt. The most popular concept postulates that the atresia results from embryological malformations. In support of this view, Ylpo and Ladd point out that the bile ducts are tubular at first, and then by a proliferation of their epithelium, they are converted into solid cords. If normal development ensues, these cords undergo segmental vacuolation, the vacuoles coalesce and re-establish the ductal continuity. Partial or complete failure of vacuolation or fusion readily accounts for the great variety of anatomical anomalies.

Another theory holds that the atresia results from a primary intra-uterine hepatic cirrhosis, followed by a descending cholangitis which produces a fibrous occlusion of the biliary radicals. Rolleston and Hayne believe that toxins, either of maternal or fetal origin, initiate the cirrhosis. Accumulated evidence, however, suggests that the cirrhosis is the effect, rather than the cause, of the occlusion of the extrahepatic bile ducts. Some thought that a luetic hepatitis was the primary disease, but Holmes exploded this postulate by negative serological studies in all his cases.

It seems reasonable to believe, as pointed out by Holmes, that both of the theories mentioned have a certain degree of merit. The congenital malformation of the biliary radicals produces a stasis of bile, and the chemical irritation and the secondary cholangitis accelerates the fibrosing processes.

## ANATOMY

Every conceivable type of atresic malformation of the bile ducts has been reported, but in spite of the multiform variations certain general groupings can be made: (1) agenesis of the extrahepatic bile ducts, (2) complete or segmental atresia of the hepatic ducts, (3) complete or segmental atresia of the choledochus, (4) complete or segmental atresia of the gall bladder and cystic duct with patency of the common and hepatic ducts, (5) complete or segmental atresia of the cystic and hepatic ducts—the type most frequently encountered, (6) atresia of the extrahepatic bile ducts with patency of the cystic duct and gall bladder, (7) agenesis of the extrahepatic ducts with the gall bladder connected directly to the duodenum, (8) mechanical obstruction of the patent bile ducts by plugs of mucus, inspissated plugs of bile, stones, and inflammatory edema of the ampulla Vater.

Holmes found that in 16 per cent of all atresic lesions, the cystic and hepatic ducts were patent. This is very significant for such deformities are amenable to surgical correction. Figure 1 represents the malformations encountered in our cases none of which were of the remedial variety due to the complete obliteration of the common hepatic bile duct.

#### SYMPTOMS

Jaundice is the most constant symptom in congenital atresia of the bile ducts. There can be no doubt however that stenosing lesions of the gall bladder and cystic duct occur rather frequently but as they do not impede the outward flow of bile they remain asymptomatic. The jaundice may be present at birth but it usually appears during the first 3 weeks of life. Ylpo maintains that the biliary pigments are not elaborated in very large quantities until birth therefore the icterus does not become evident until hepatic saturation has been reached. The skin sclera, and mucous membranes assume a yellowish green color which differs from the yellowish tinge seen when biliary stasis occurs in the adult. The icterus is progressive but may show slight daily variations. The van den Bergh test gives a positive direct reaction and is not biphasic.

The stools are acholic, but at times they may give a positive reaction for bile. This does not indicate a patency of the biliary tract as is often thought but is caused by the cholemic blood oozing from the vessels of the intestinal mucosa. Large amounts of undigested fats may be recovered from the feces, particularly if the obstructive process occludes the ducts of Wirsung and Santorini. In spite of the dysfunctions of the liver and pancreas these infants maintain a surprisingly good state of nutrition until toward the end.

The liver is always enlarged. Irregular in outline and may occupy most of the abdominal cavity. Splenomegaly and ascites usually result from passive congestion.

Petechial spots appear in the skin and mucous membranes while spontaneous hemorrhages occur from the nose, umbilicus, and gastro-intestinal tract. Profuse bleeding may follow the most trivial trauma. The bleeding

and clotting time are usually normal or just slightly prolonged. The fragility of the red blood corpuscles is not altered and the number of erythroblasts is not increased. If an anemia exists, it is of the secondary type.

#### DIAGNOSIS

Difficulty is frequently encountered in making an accurate diagnosis of congenital atresia of the bile ducts during the first month of life but thereafter it can be accomplished with ease.

*Icterus neonatorum* occurs in 30 per cent of all newborn children. The jaundice is usually mild, appearing on the second or third day and soon subsides spontaneously. Even in severe cases the liver does not become enlarged and the stools contain bile pigments.

*Congenital hemolytic icterus* seldom affects young children and can always be recognized by the increased fragility of the erythrocytes.

*Lactis hepatitis* may produce a mild jaundice but accurate maternal and infantile serological studies supplemented by the roentgenological examination of the long bones of the child afford accurate differentiation.

*Erythroblastosis* or *icterus gravis* affects the infant during the first few days of life and may be recognized by an increase in the number of erythroblasts in the circulating blood. The van den Bergh reaction is biphasic. Unfortunately this disease runs a very rapid course and has an extremely high mortality therefore it seldom produces a chronic icterus.

*Hemolytic icterus due to sepsis*. Any infection which produces a rapid hemolysis of the red blood cells may initiate a mild icterus. The leucocytosis, the febrile reaction, the recognition of the infective focus, the presence of bile pigments in the stools, and the absence of hepatic enlargement usually lead to a correct diagnosis.

#### PROGNOSIS

Complete biliary stasis is incompatible with life. Surgical correction of existing abnormalities affords the only hope of relief. Refinements in diagnostic and surgical technique make it possible to salvage 20 to 30 per cent of these unfortunate children.

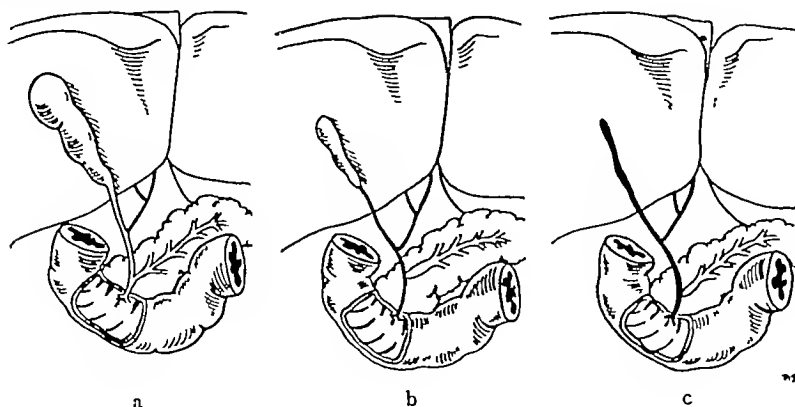


Fig 1 Anatomical classification of the authors' cases a, Cases 1 and 2 Complete atresia of the common hepatic and the right and left hepatic ducts b, Cases 4 and 5 Complete atresia of the cystic duct, the common duct, and all hepatic bile ducts Note the obstruction of the pancreatic ducts c, Case 3 Complete atresia of the entire extrahepatic biliary system

### TREATMENT

Medical therapy has but one aim, that of improving the general condition of the infant so as to minimize the operative hazards. The administration of bile salts and vitamin concentrates helps compensate for existing deficiencies. Vitamin K, transfusion of whole blood, and hypertonic solutions of glucose are valuable in combating hemorrhagic tendencies.

Ladd and Donovan maintain that surgical intervention should be postponed until after the first month as positive diagnosis cannot be made prior to that time. Procrastination beyond this period, however, merely permits malnutrition, hemorrhages, and infectious processes to deplete the patient's reserve and thus increase the operative risk.

Surgical correction of the biliary stasis is predicated on two fundamental premises, first, the recognition of existing abnormalities, and second, the ability to provide a new channel through which the bile may flow into the gastro-intestinal tract. All too frequently, neither of these objectives can be accomplished, and the patient dies.

The multiplicity of variations, the small caliber of the infantile bile ducts, the enlargement of the liver, and the associated periductal fibrosis incident to concomitant infections certainly do not facilitate the recognition of the congenital deformities. Anyone who has attempted the tedious task of dis-

secting out the improperly developed gall bladder and bile ducts appreciates the futility of such procedures. One soon becomes lost in the maze of blood vessels, nerves, bile stained connective tissue, and fibrotic bile ducts. This is particularly true if the hepatic ducts are impervious, for then the distal segments of the biliary tract are small, collapsed, and undeveloped. Ladd appreciated this difficulty and suggested that the collapsed gall bladder be distended with saline solution so that bile ducts could be more readily identified. This procedure is invaluable if all the bile ducts are patent but if the cystic duct is obliterated, the saline solution can not distend the choledochus and hence is of no value.

Previously we had demonstrated that it was possible, by means of contrast roentgenography (1, 5), to obtain exact anatomical patterns of the adult biliary tract while the patient was on the operating table. It was hoped that these cholangiographic studies might prove helpful in visualizing and locating the obstructive lesions affecting the diminutive biliary tract of the infant. These cholangiograms not only facilitated the classification of the obstructions but greatly aided the surgeons in selecting the proper remedial procedure.

### CASE HISTORIES

CASE 1 (Hicken) M E, a white male child, 5 months of age, was referred by Dr Bruce Eldridge,

because of progressive painless jaundice. The icterus was first observed 3 weeks following birth and had steadily increased in intensity. Several times it was "thought that the stools contained bile. Malnutrition, asthenia, hemorrhages from the bowels and susceptibility to pulmonary infections finally convinced the parents that surgical intervention was imperative.

On examination the liver was found to occupy the major portion of the abdominal cavity. It was firm, irregular and tender. There was mild ascites. The spleen was about twice the normal size. There were 3,500,000 erythrocytes, 300 leucocytes, and the hemoglobin was 70 per cent. The bleeding and clotting time, as well as the fragility of the red blood corpuscles, were all of normal values. The Kluge and Wassermann reactions were negative.

Vitamin concentrates, bile salts, hypertonic solutions of glucose and transfusions of whole blood were given in an effort to combat the malnutrition. An exploratory laparotomy was performed, but the gall bladder and extrahepatic bile ducts could not be identified in the periportal structures. It was thought that the gall bladder might be collapsed, therefore a needle was inserted into the tissues occupying the gall bladder fossa and cubic centimeter of contrast substance was slowly introduced (Fig. 1). Much to our surprise the small atrophic gall bladder became distended and could be readily palpated. Cholangiograms demonstrated the gall bladder, the cystic and common bile ducts, and the pancreatic ducts to be patent. The contrast substance readily entered the duodenum (Fig. 2). The visualizing media, however, was unable to enter the impervious hepatic ducts because of an occluding fibrosis. Further exploration revealed that both the right and left hepatic ducts had been converted into fibrous cords and that the obstructive process was intrahepatic. It was obvious that there was no possible way in which the liver could be decompressed and the bile diverted into the duodenum hence the abdomen was closed. A terminal bronchopneumonia proved fatal 47 hours later.

Necropsy examination demonstrated that the cholangiographic studies were correct. The gall bladder, cystic, and common bile ducts were normal, but the common hepatic, the right and left hepatic ducts, and the intrahepatic ducts were solid cords. Histologic studies failed to demonstrate either the duct lumen or its mucosal lining. The fibrosing process followed each of the hepatic ducts into the liver substance for a distance of 4 centimeters, thus making decompressive procedures impossible. The intrahepatic bile ducts were definitely dilated, and the liver presented the picture of bile stasis and cirrhosis.

CASE (Hicken) H. V., white male child, 3 months of age entered the University of Nebraska Hospital on the pediatric service of Dr. E. W. Bant. The icterus, as present at birth and had progressively increased in severity. The stools were always acholic. Purpuric spots had been observed

on the knees and ankles at various times. A pernicious vomiting and a persistent bloody diarrhea had rapidly depleted the physical reserve.

The liver was hard, irregular and extended downward to the crest of the ilium. The spleen was about 35 times larger than it should be. The icteric index was 60 and the van den Bergh gave a direct and positive reaction. The urine contained bile but the stools were cholic. The Kluge and Wassermann reactions were negative. There are 3,000,000 red blood cells, 1,000 leucocytes, 0,000 blood platelets and 3.5 per cent reticulocytes. The fragility tests were normal.

An exploratory laparotomy revealed a large bile stained cirrhotic liver. The gall bladder fossa contained a small amount of smooth tissue from which no fluid could be aspirated. In spite of a most meticulous dissection we were unable to identify the common bile duct. Attempts to distend the collapsed gall bladder with saline solution, as advised by Ladd, failed. In hopes of visualizing the bile ducts the duodenum was opened and a small cannula was inserted into the ampulla of Vater through which cubic centimeter of contrast substance was introduced. Cholangiograms demonstrated the ampulla of Vater, choledochus, pancreatic ducts, cystic duct, and gall bladder to be normally developed and patent. The contrast media, however, failed to enter the common hepatic duct thus demonstrating complete obliteration of its lumen. No decompressive procedures could be employed as the biliary stasis resulted from occlusion of the intrahepatic segments of the right and left hepatic ducts. The abdomen was closed, and the patient succumbed 36 hours later.

Necropsy studies revealed the cirrhotic liver to weigh 300 grams, and the spleen was twice its normal size. Pressure on the small gall bladder forced the contrast media, which had been introduced at the time of operation along the bile ducts out into the duodenum, thus attesting to the patency of these radicals. The hepatic ducts could not be identified for even microscopic sections through the periportal fibrotic tissues failed to locate mucosal linings or ductal structures. LI. Case, this must be classified as complete atresia of the common hepatic and the right and left hepatic ducts.

This case emphasizes the point that the visualizing media may be introduced into any portion of the extrahepatic biliary system that is patent. Whenever possible it should be injected into the gall bladder but if this cannot be accomplished, the exploring needle may be inserted into the choledochus, the hepatic ducts, or even into the ampulla of Vater. It is true that these transduodenal injections carry a high mortality but when one appreciates the seriousness of these conditions, and when all other methods have failed to

locate the obstructive lesion, then one is justified in performing these transduodenal cholangiograms

CASE 3 (Best-Hicken) B J, a white female child, 5 months of age, was first seen with Dr R R Best. A progressive, painless jaundice since birth, combined with acholic stools, enlargement of the liver and spleen, and a normal fragility test, suggested the diagnosis of congenital atresia of the bile ducts.

We explored the abdomen and found the liver to be greatly enlarged. The dense mass of bile stained cicatricial tissue which occupied the area surrounding the portal vein made it impossible to identify any portion of the extrahepatic biliary system. The gall bladder fossa was very small and no remnants of the gall bladder could be detected. In spite of a most tedious and painstaking dissection we were unable to identify any portion of the bile ducts. The impervious state of the extrahepatic ducts made it impossible to utilize the visualizing cholangiograms, therefore we were compelled to make the diagnosis of complete atresia of the entire extrahepatic biliary system. Autopsy studies confirmed the diagnosis and also revealed the futility of attempting decompressive procedures.

CASE 4 (Henske) P P, a white male child was first seen by Dr Henske when only 3 months of age



Fig 3 The cholangiogram clearly outlines the gall bladder, common bile duct, and duodenum, indicating that they are patent. An obstructive lesion of the common hepatic bile duct prevented the contrast substance from outlining the right and left hepatic ducts or the intrahepatic radicals.

At this time, the child had a pronounced jaundice, acholic stools, biluria, and enlargement of the liver. The diagnosis of congenital atresia of the bile ducts was made and operation was advised. The parents declined permission for operation, therefore the

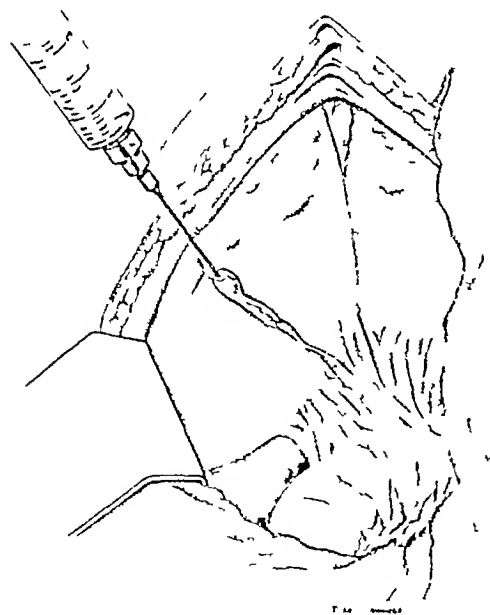


Fig 2 Demonstrating the technique of introducing the contrast substances into the gall bladder in order to obtain accurate roentgenographic patterns of the bile ducts during the operation.

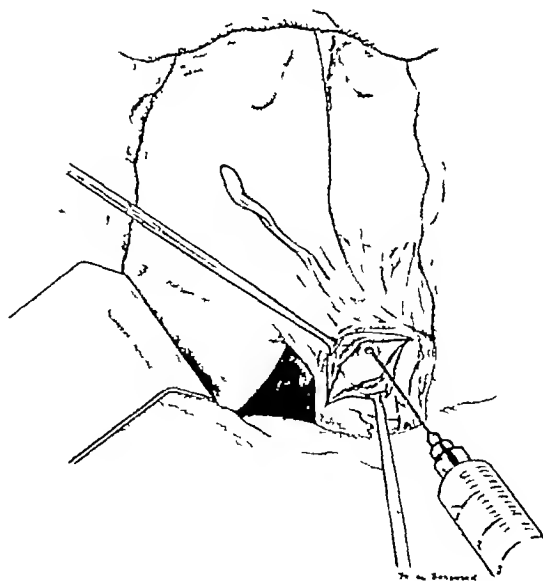


Fig 4. When the extrahepatic bile ducts cannot be identified, we have opened the duodenum and informative cholangiograms have been obtained by introducing the contrast substance directly into the ampulla of Vater.



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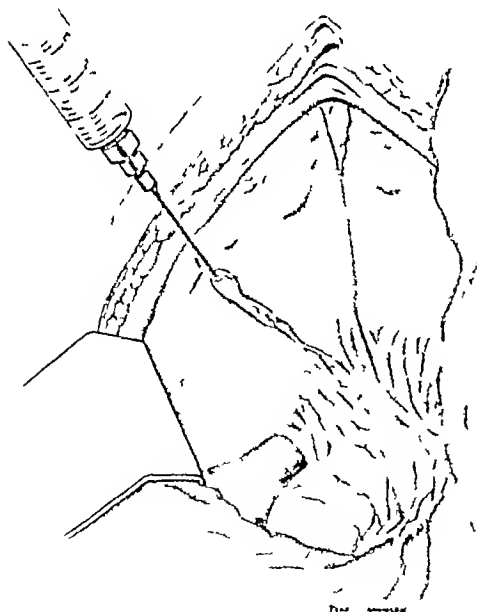


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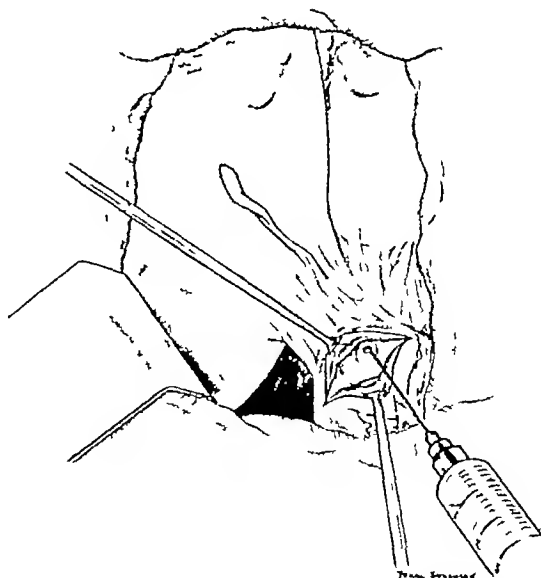


Fig 4. When the extrahepatic bile ducts cannot be identified, we have opened the duodenum and informative cholangiograms have been obtained by introducing the contrast substance directly into the ampulla of Vater.



Fig. 5a.

Fig. 5. a, The cholangiogram of Case clearly outlines the ampulla of Vater, pancreatic duct, choledochus, and the gall bladder. However, the failure of contrast substance to enter the hepatic ducts and intrahepatic radicals indicates that the obstructive lesion is at or above these segments. b, Gross specimen showing small gall bladder and



Fig. 5b

patent cystic and common bile ducts. The common hepatic, the right and left hepatic ducts, and intrahepatic segments are completely occluded.

youngster was discharged in spite of high caloric diets rich in vitaminic and bile salts content, the youngster died 3 weeks later from a severe pneumonia and gastro-intestinal hemorrhages.

Necropsy examination confirmed the hopeless nature of this disease by showing the gall bladder to be patent and slightly distended with mucus. The cystic duct, hepatics, and choledochus had been converted into fibrous cords. No plastic operation could have been employed.

CASE 3 (Henske) L.C. white female child, as apparently normal at birth but 3 days later developed a slight icterus. The jaundice slowly increased in intensity and failed to respond to the common remedial agents so the patient as referred to D. J. A. Hensel. Bilirubin, cholic stools intense jaundice,

malnutrition, melena, and hepatomegaly suggested the diagnosis of congenital obstruction of the bile ducts.

Dr. Henske did not believe that this case remedial surgery, therefore he gave supportive treatments in the form of vitamin concentrates, blood transfusions, and bile salts. During the next 3 weeks she made pronounced improvement but later contracted a pneumonia and died less than 3 months old.

At autopsy Dr. C. F. Baker found the abdominal cavity to contain 300 cubic centimeters of bile stained fluid. The liver weighed 400 grams and was deeply pigmented and cirrhotic. Its markings were indistinct, but the intrahepatic ducts were all dilated. The gall bladder was small and atrophic but patent. The cystic duct, the hepatic ducts, and the choledochus were all fibrotic and occluded. The ampulla of Vater and the pancreatic ducts were all normal. It was evident that surgical correction of obstructive lesions was absolutely impossible.

#### SELECTION OF OPERATION

Not all types of atresic obstructions are amenable to surgery for some of them are so extensive that complete restoration is impossible. In other varieties the lesion is situated in such inaccessible places that new conduits for the passage of bile cannot be constructed. Those atresic lesions which can be corrected are represented by the cholangiograms seen in Figure 7. It will be noted that in every instance the intrahepatic radicals, the right and left hepatics, and the common



Fig. 6. Small atrophic gall bladder with complete atresia of all other components of the intrahepatic and extrahepatic bile ducts.

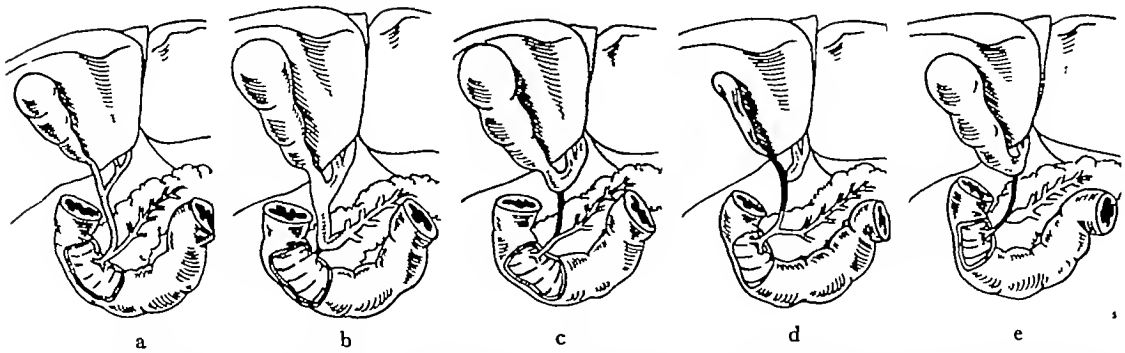


Fig 7 Remedial lesions of the bile ducts a, Normal biliary system. b, Obstruction of the ampulla of Vater may be relieved by flushing, dilatation, cholecysto-enterostomy, and choledocho-enterostomy c, Occlusion of the upper two-thirds of the choledochus relieved by cholecysto-

enterostomy d, Occlusion of the upper two-thirds of the choledochus and the cystic duct relieved by hepatico-duodenostomy e, The obstruction of the bile ducts can be overcome by a cholecysto-enterostomy A pancreaticoduodenostomy could be attempted later

hepatic bile ducts were all patent. The bile must have free access to the extrahepatic ducts, and there must be sufficient amount of normal ductal tissue to permit short-circuiting plastic operations. The type of operation employed depends entirely on the extent and location of the occlusion.

If the obstructive lesion is located in the ampulla of Vater (Fig 7 b), distal to the openings of the pancreatic ducts, the outlook is very favorable. Ladd has pointed out that if plugs of inspissated bile or mucus should occlude the choledochoduodenal orifice that they can be dislodged by gently irrigating the gall bladder with a solution of saline. If this fails to disengage the impacted plugs, he suggests that a small probe be passed along the choledochus into the duodenum. If such simple procedures relieve the obstruction nothing more need be done. In some cases, however, there is a dense fibrous occlusion of the ampullar orifice making it necessary to perform a choledochoduodenostomy. This is the operation of choice but if the patient's condition is serious, a simple cholecystogastrostomy may suffice. In all such operations it is essential to know that there is no obstruction proximal to the site of anastomosis. Such information is readily obtained by means of cholangiography.

Occasionally a segmental atresia involving the upper two thirds of the choledochus will be encountered (Fig 7 c). If the ampullar segment is patent, thus affording an outlet for

the pancreatic hormones, a cholecysto-enterostomy is very effective. One must be certain that the cystic duct is patent, otherwise the liver will not be decompressed of its bile stasis.

The combined atresia of the choledochus and the cystic duct is frequently encountered (Fig 7 d). The gall bladder may be collapsed or distended with a yellowish mucoid material which may be mistaken for bile. The introduction of contrast media into the gall bladder will readily visualize the occlusive lesion of the cystic duct and thus prevent a useless cholecysto-enterostomy. When the common hepatic duct is distended, it may be anastomosed to the duodenum. Ladd, with inexhaustible ingenuity, performed such an operation by employing a small rubber catheter which he inserted into the hepatic duct and then anchored to the duodenum, thus forming a new channel for the flow of bile. The minuteness of the infantile ducts makes this a most delicate procedure but one worth attempting.

Obliteration of the lower third of the common bile duct is a serious condition (Fig 7 e) for it means that the ducts of Wirsung and Santorini are definitely occluded. It is true that a cholecysto-enterostomy will completely relieve the biliary stasis but unless a new outlet is provided for the pancreatic secretions the ensuing asthenia may prove fatal. By means of cholangiographic studies one can determine the status of the pancreatic ducts and, while plastic repairs may be difficult to perform, it is a challenge which must be met.

It is evident that the intrahepatic radicals and the common hepatic bile duct with its two tributaries must be patent if a reconstructive decompression of the liver is to be accomplished. If a new conduit for the egress of bile can be established the patients make a complete and gratifying recovery. Many cases that have been reported as inoperable were so classified because of the surgeon's inability to isolate the biliary radicals and not because of the type of atresic lesion. These cholangiograms not only visualize the exact location and extent of the existing malformations but also furnish evidence which is helpful in selecting the proper therapeutic procedure. This is clearly portrayed in Cases 1 and 2 as the cholangiograms revealed the gall bladder cystic duct, and choledochus to be patulous, hence a cholecysto-enterostomy seemed indicated but they also demonstrated a complete atresia of the common hepatic ducts and its radicals thus rendering such an operation ineffective.

Attempts to decompress the biliary stasis by scarifying the surface of the liver in such a manner that the peripheral intrahepatic bile ducts would be severed and then anastomosing this traumatized area to the stomach have in our hands resulted in death either from hemorrhage or infections.

#### SUMMARY

1. Embryological malformations apparently account for the congenital atresias and obstructions of the extrahepatic bile ducts.

2. This disease is usually characterized by a progressive painless jaundice which appears during the first 3 weeks of life and is associated with hemorrhagic tendencies malnutri-

tion enlargement of the liver splenomegalia and ascites.

3. Corrective surgery which establishes a new channel for the flow of bile into the intestinal tract, thus decompressing the liver offers the only hope of cure. It has been held that all of these cases are hopeless but recent studies indicate that from 20 to 30 per cent are amenable to surgery.

4. The method of visualizing these ductal deformities at the time of operation is presented. These cholangiographic studies determine the location and extent of the obstructive lesion.

5. Five cases of congenital atresia of the bile ducts are presented but in all of them, the obstructive lesions were in such positions that it precluded the possibility of surgical repair.

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# THE SUPERIORITY OF NEOARSPHENAMINE AND SULFATHIAZOL IN THE THERAPY OF STAPHYLOCOCCUS AUREUS INFECTIONS IN MARROW CULTURES

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THE development of the marrow culture method (15) has made possible accurate quantitative comparison under controlled conditions of the relative effectiveness of therapeutic agents against bacterial infections in the presence of living human cells (1, 9 to 14). The *Staphylococcus aureus* is a frequent cause of human infection, and is relatively resistant to therapy with sulfanilamide and sulfapyridine (8). LeCocq (5) and LeCocq (6) have obtained good results in *Staphylococcus aureus* infections with neoarsphenamine. The new compounds, sulfathiazol and sulfamethylthiazol, have been reported (2, 3, 4, 7) to be more effective in *Staphylococcus aureus* infections than other drugs. The object of this study was to determine the most effective of these drugs in the therapy of *Staphylococcus aureus* infections and the ideal concentration.

## METHOD

Cultures of human bone marrow were prepared as described (1, 9-15). To about 50 cubic centimeters of culture containing about 100,000,000 nucleated marrow cells in one vial was added with syringe and needle a dilution of a culture of *Staphylococcus aureus* in Hartley broth. After thorough mixing, pour plates were made for colony counts, and equal volumes of about 8 cubic centimeters were then transferred to each of a number of 30 cubic centimeter vaccine vials. This insured that each vial contained the same number of the same strain of organisms and the same number of cells in identical medium. To each of these, except the control, enough of the drug to be studied was added to give the desired concentrations. The cultures were

then placed in incubator at 37 degrees C., and pour plate colony counts and smears were made at intervals. This technique insures that the only variable is the presence of the drug.

## RESULTS

In all, a total of 20 experiments similar to the 7 shown in Tables I to VII were done. They were consistent in showing that sulfanilamide and sulfapyridine were relatively ineffective (Tables I to VII, and Figures 17, 18, 19, and 21 in reference 12) and that neoarsphenamine was very effective (Tables I to VIII). Preliminary reports of these studies were made (12, 13). It was soon discovered that neoarsphenamine in concentrations above 1:70,000 not only led to sterility of the cultures but also destroyed the marrow cells, and that in concentrations between 1:70,000 and 1:150,000 the marrow cells were damaged. Concentrations below 1:400,000 were much less effective than higher concentrations (Table I), and concentrations below 1:200,000 were somewhat less effective. The ideal concentration, therefore, is apparently 1:150,000, or about 6 parts per million. In this concentration, however, the drug has to be present for 6 to 48 hours or longer to be effective.

TABLE I—COMPARATIVE EFFECTIVENESS OF SULFANILAMIDE, SULFAPYRIDINE AND VARYING CONCENTRATIONS OF NEOARSPHENAMINE ON STRAIN 1, TABLE VIII

Hours	0	24	72
Control	60	87,500,000	800,000,000
Sulfanilamide 1:10,000	60	38,000,000	250,000,000
Sulfapyridine 1:10,000	60	12,000,000	162,000,000
Neoarsphenamine 1:100,000	60	50	2,700
Neoarsphenamine, 1:263,000	60	600	5,000,000
Neoarsphenamine 1:400,000	60	4,000	13,000,000

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TABLE II.—COMPARATIVE EFFECTIVENESS OF VARYING CONCENTRATIONS OF NEOARSPHEN AMINE ON STRAIN 1 TABLE VIII.

Hours				24	48
Control	10	30	37	200,000,000	
Neosarphenamine 87,000	70	90			
Neosarphenamine, 50,000	70				
Neosarphenamine, 1,000	90	90			
Neosarphenamine, 500,000	70	90	75		1

(Tables I to VII) Sulfathiazol and sulfamethylthiazol in concentrations of 1:10,000 (Tables IV to VII) were also very effective but were not as effective as neoarsphenamine (Tables IV to VIII and Figures 1-4). The results of all the tests made on each of the strains of *Staphylococcus aureus* investigated are summarized in Table VIII. Note that in 1:10,000 concentrations sulfanilamide was ineffective and sulfapyridine was only slightly effective in both tests reported, as was ex-

TABLE III.—COMPARATIVE EFFECTIVENESS OF VARYING CONCENTRATIONS OF NEOARSPHEN AMINE ON STRAIN 1 TABLE VIII.

Hours		5	27
Control	30	370	> 200,000,000
Neosarphenamine, 1,300	30	15	
Neosarphenamine, 67,300	30		
Neosarphenamine, 130,700	30	30	100
Neosarphenamine, 56,000	30	40	
Neosarphenamine, 500,000	30	30	1

pected from our previous studies. Sulfathiazol in 1:10,000 concentrations was definitely superior to sulfapyridine. In the 10 experiments in which it was studied sulfathiazol was very effective in 2, effective in 3, slightly effective in 5, and ineffective in only 1. It failed to result in sterility of any culture although if smaller inoculations had been made it is possible that it might have produced sterility. Sulfamethylthiazol in 1:10,000 concentrations was almost as effective as sulfathiazol in the marrow cultures. In the

TABLE IV.—COMPARATIVE EFFECTIVENESS OF SULFATHIAZOL, SULFAMETHYLTHIAZOL AND NEOARSPHEN AMINE ON STRAIN 2 TABLE VIII.

Hours				24	48
Control		1,300	1,300	10,000	> 200,000,000
Sulfathiazol, 10,000		1,300	1,300	11,000	30,000
Sulfamethylthiazol, 10,000		300	6,000	1,000	1,000,000
Neosarphenamine, 50,000		300	500	1,000	15,000

TABLE V.—COMPARATIVE EFFECTIVENESS OF SULFATHIAZOL, SULFAMETHYLTHIAZOL AND NEOARSPHEN AMINE ON STRAIN 4 TABLE VIII.

Hours		24	48	48	48
Control	10,000 <sup>2</sup>	200,000,000			
Sulfathiazol, 10,000	30,000 <sup>2</sup>	1,000,000	1,000,000	200,000,000	
Sulfamethylthiazol, 10,000	30,000 <sup>2</sup>	1,000,000	1,000,000	200,000,000	
Neosarphenamine, 30,000	50,000 <sup>2</sup>	10,000	500		700

TABLE VI.—COMPARATIVE EFFECTIVENESS OF SULFATHIAZOL, SULFAMETHYLTHIAZOL AND NEOARSPHEN AMINE ON STRAIN 5 TABLE VIII.

Hours		24	48	48	48
Control	1,300	10,000	200,000,000		
Sulfathiazol, 10,000	1,300	50,000	500,000	100,000	200,000,000
Sulfamethylthiazol, 10,000	100	50,000	200,000	500,000	200,000,000
Neosarphenamine, 30,000	50	500	500	500	1,000



Fig 1 Photomicrograph of the control from the experiment which is shown in Table VI at 24 hours Wright's stain,  $\times 810$



Fig 2 Photomicrograph of the culture containing 1:10,000 sulfathiazol at 24 hours from the experiment shown in Table VI Wright's stain,  $\times 810$

7 studies, it was very effective in 1, effective in 1, slightly effective in 4, and ineffective in 1. Neoarsphenamine in concentrations above 1:100,000 resulted in sterility of the cultures in all 13 trials, but damaged or destroyed marrow cells in these concentrations. In concentrations of 1:100,000 to 1:200,000 neoarsphenamine was superior to any other therapy investigated. Eight of 29 cultures investigated were sterilized, in 16 cultures it was very effective, in 3 it was effective, in 3 it was slightly effective, and in only 1 was it ineffective. In concentrations of 1:200,000 to 1:400,000 neoarsphenamine was of some value but not as effective as in higher concentrations. In 8 studies 2 cultures became sterile, in 3 it was very effective, in 2 it was effective, and in 1 it was slightly effective. It is apparent from this study that in marrow cultures the ideal concentration of neoarsphenamine is 1:150,000 to 1:200,000.

#### ANALYSIS OF STUDY

These studies indicate that, as with the *Streptococcus viridans* (12, 13, 14), sulfanilamide is ineffective against *Staphylococcus aureus* in concentrations obtainable in the blood stream. Sulfapyridine is somewhat superior to sulfanilamide, but it is much less effective than sulfathiazol or sulfamethylthiazol. Sulfathiazol and sulfamethylthiazol are very effective, but they rarely lead to sterility in marrow cultures. In 1:10,000 concentrations they are definitely inferior to neoarsphenamine in concentrations of 1:100,000 to 1:200,000.

The development of an accurate method for blood arsenic by Raulston, Magnuson and Chaney (16, 17) made possible the calculation of the laws governing the distribution of the drug in the body and its elimination from the blood in man. After a single dose the drug is distributed evenly through the blood volume,





Fig. 3. Photomicrograph of the culture containing 0.000 sulfamethylthiazol 24 hours from the experiment shown in Table VI. Wright stain, X8.



Fig. 4. Photomicrograph of the culture containing 0.000 neorsphenamine at 24 hours from experiment shown in Table VI. Wright stain, X8.

but rapidly leaves the blood and after 2 to 3 hours is distributed almost evenly throughout the body tissues. From this time on the blood level drops comparatively slowly. During both periods the drug leaves the blood by a clearance mechanism which corresponds to a clearance of about 50 cubic centimeters of blood per hour. To maintain continuously the blood level desired of one part in one hundred and fifty thousand, or 200 gamma of

arsenic per 100 cubic centimeters as the results are reported one should give  $\frac{1}{150,000}$  of the body weight in grams of neorsphenamine  $\left( \frac{\text{body weight in kg.} \times \text{body weight in pound}}{150} \right)$  the first day divided into 3 or 4 spaced doses. Each subsequent day until 6 to 10 days after the patient is afebrile give three fourths of the total dose given on the first day divided

TABLE VII.—COMPARATIVE EFFECTIVENESS OF SULFANILAMIDE, SULFAPYRIDINE, SULFATHIAZOL, SULFAMETHYLTHIAZOL AND NEORSPIHENAMINE ON STRAIN 7. TABLE VIII

Hours					
control	1,000	10,000	100,000	1,000,000	
Sulfanilamide, 10,000	1,000	10,000	10,000	10,000,000	
Sulfapyridine, 10,000	1,000	5,000	17,000	100,000	100,000,000
Sulfathiazol, 10,000	1,000	5,000	5,000	11,000	100,000,000
Sulfamethyl thiazol 100	100	100	1,000	10,000	100,000,000
Neorsphenamine, 10,000	1,000	5	10	10	

TABLE VIII—SUMMARY OF RESULTS WITH ALL DRUGS STUDIED ON SIX STRAINS OF STAPHYLOCOCCUS AUREUS

Strains	1	2	3	4	5	6
Sulfanilamide	1 I					1 I
Sulfapyridine	1 S					1 S
Sulfathiazol			2 S 1 I	2 V 1 S	1 S	2 E 1 S
Sulfamethylthiazol			2 S 1 I	1 V 1 S	1 S	1 E
Neoarsphenamine 1 100 000	13 O					
Neoarsphenamine 1 100 000 to 1 200 000	8 O 10 V 2 E	2 V	1 E 1 S 1 I	1 V 2 S	1 V	2 V
Neoarsphenamine 1 200 000	2 O 2 E 1 S	2 V				1 V

O—the culture was sterile when the colony count in the control was more than 400 000 000 per c.cm

V—very effective or the colony count ranged from 1 to 10 000 when the colony count in the control reached 400 000 000

E—effective or the colony count ranged from 10 000 to 200 000 when the colony count in the control reached 400 000 000

S—slightly effective or the colony count ranged from 200 000 to 60 000 000 when the colony count in the control reached 400 000 000

I—ineffective or the colony count was over 60 000 000 when the colony count in the control reached 400 000 000

into three spaced doses. For example. If the body weight of the patient is 60 kilograms, give a total of 0.4 gram in divided doses of 0.1 gram each at 8 a.m., 11 a.m., 2 p.m., and 8 p.m. Every subsequent day give 0.1 gram at 8 a.m., 3 p.m., and 10 p.m. On the third day and subsequently at intervals, just before giving the 8 a.m. injection, take blood for blood arsenic determinations (17). Adjust the doses up or down as necessary to keep the blood arsenic level between 100 and 130 gamma per 100 cubic centimeters when the blood is taken at this time.

Sulfathiazol in doses sufficient to give a blood level of 8 to 10 milligrams per 100 cubic centimeters may be used alone in the milder staphylococcus infections, and in conjunction with neoarsphenamine in the most severe infections. Sulfamethylthiazol should not be used because of its tendency to produce polyneuritis. If difficulty is encountered in securing adequate blood levels of sulfathiazol, restriction of fluid may be more effective than merely increasing the dose.

Clinical studies are in progress and will be reported when enough data have been secured. Obviously much work remains to be done, both by the marrow culture technique and

clinically, to determine whether any other arsenical is as effective as neoarsphenamine. This report is made in the hope that those who have facilities for carefully controlled clinical investigation will aid us in determining as soon as possible the clinical value of this treatment in serious staphylococcal infections, such as staphylococcal bacteremias and meningitis.

#### SUMMARY

This series of controlled quantitative studies of the relative effectiveness of sulfanilamide, sulfapyridine, sulfathiazol, sulfamethylthiazol and neoarsphenamine against *Staphylococcus aureus* infections were made by the marrow culture method. In the marrow cultures neoarsphenamine in concentrations of 1 150,000 to 1 200,000 was the most effective preparation. In concentrations of 1 10,000 sulfathiazol and sulfamethylthiazol were of definite value but rarely led to complete sterility, sulfapyridine was only slightly effective, and sulfanilamide was practically ineffective. Concentrations of neoarsphenamine above 1 150,000 were toxic to the marrow cells, and concentrations above 1 70,000 killed all cells. These studies suggest that administration of neoarsphenamine in intermittent courses of repeated small doses together with sulfathiazol in doses sufficient to give a blood concentration of 1 10,000 is worthy of controlled clinical investigation in serious *Staphylococcus aureus* infections.

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## THE HYDRATION OF HYPERTHYROID PATIENTS AND ITS RELATIONSHIP TO EDEMA ESPECIALLY CEREBRAL

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THE work of Collier Maddock and their associates (6) has done much to focus attention on the subject of hydration of the surgical patient and as a result of their efforts surgeons in general are "water-conscious" to an extent unthought of 10 years ago. This has been to the enormous benefit of surgical patients as a whole and has keenly stimulated interest in the derangement of physiological processes that occur in dehydration. Many of the problems of water balance in disease are unsolved however since our knowledge of colloidal chemistry is still fragmentary compared with what we may hope it to be in the future. That the figures Collier and Maddock consider a desirable water intake for the average surgical patient are ideal is not clear as yet. Theoretical objection to the application to disease of Newburgh's formulas which involve a number of assumptions, have been voiced by Peters. The estimation of insensible perspiration moreover by

the weighing of as many components as are involved in the calculations of Collier and Maddock introduces quantities of weight of much greater magnitude than the calculated weight of water lost by insensible perspiration. Very trifling errors in the former would therefore be greatly magnified in the latter. There is also a certain dissatisfaction among clinicians with the results of giving sufficient water in what ever solution and particularly by vicarious routes of intake necessary to produce a urinary output of 1500 cubic centimeters per day plus an allowance of 1500 to 2000 cubic centimeters daily for insensible perspiration above all other fluid losses. Elderly patients in general are more apt to develop water retention on such a regimen than are younger subjects, even though they originally have not clinically demonstrable functional or anatomical disorders of the circulatory system. The occurrence of pulmonary edema which often overtakes the patient suddenly in such post-operative patients may precipitate a critical situation.

The author has been particularly interested in this phenomenon in patients with hyperthyroidism and it is with the problem of their hydration that we are immediately concerned. As stated, there is still much mystery attached to the ways in which the tissues handle water, particularly in disease, as studies of even the factors known to be involved are incomplete. A tendency to water retention, i.e., to edema, is determined primarily by variations in balance between hydrostatic pressure in the capillaries and the colloid osmotic pressure of the blood, the latter is affected by changes of the plasma proteins, particularly of the albumin fraction, and of the electrolytes. There is every reason to think that hydrostatic pressure in the capillaries is increased in hyperthyroid patients, increased minute output of the heart and high pulse pressure being well recognized, peripheral vasodilatation may well be a compensatory effort to keep capillary pressure as nearly normal as possible, as well as increasing dissipation of heat by favoring both radiation and insensible water loss from the skin. The figures of Collier and Maddock (5) indicate an increase both in percentage and amount of heat lost through vaporization of water with rising metabolism and the assumption seems currently reasonable that capillary dilatation in the lungs occurs also and serves the same ends.

A search for disturbances in the concentration of electrolytes (10) of the blood in thyrotoxicosis has been fruitless so far, this is hardly surprising, so far as the cations are concerned, for their constancy, particularly that of sodium, is guarded with the utmost care. Total electrolyte concentration and pattern seem to vary in disease much less widely than colloid osmotic pressure or even the total osmotic pressure of the plasma (12). There is evidence (1, 4) that the plasma proteins are decreased, especially the albumin fraction (1) and unpublished data of our own indicate a further rather sharp decrease of albumin in the immediately postoperative phase, often with a rise in globulin and a reversal of the albumin-globulin ratio. For any prediction of the tendency to water retention it is necessary to know the plasma volume as well as the concentration of plasma proteins, and there is no

agreement as to the facts in hyperthyroidism. Rowntree and Bartels refer to an increased plasma volume while Brown and McCray, and Frazier and North consider it to be decreased. This point has an important bearing on the situation and needs clarification. It must be realized that the blood does not necessarily take part in edema and that with reduced serum protein the volume of circulatory blood is probably not large (12). Further factors modifying the behavior of water in the body are tissue tension and the existence of anoxemia. Large weight loss, which favors the development of decreased tissue tension, and a tendency to anoxemia are common features in the clinical course of hyperthyroidism, an "arteriolarization" of the venous blood, that is, a decreased A-V difference of oxygenation, has been demonstrated by Gladstone. One cannot simply count on the functional ability of the kidneys to excrete all water above the needs of the tissues in disease and this is a trap into which clinicians are prone to fall. The kidneys are more concerned with the maintenance of serum electrolytes in normal quantities and concentration than anything else, while they are not indifferent to the total body water content, their response seems more directly related to composition than to volume of body fluids (12).

The importance of the considerations outlined lies in the fact that the known or suspected deviations from normal mechanisms in hyperthyroidism all work in the direction of retention of water. That the body does not handle water normally in exacerbations of thyrotoxicosis, such as postoperative reactions, is indicated in the figures of Collier and Maddock (5) which show a gain in weight in the first and sometimes the second postoperative days at the time fever is increasing. We have long been impressed with the frequency in severe exacerbations, the spontaneous or postoperative "crisis in miniature," of profuse bronchial and tracheal mucous secretion amounting to "bronchorrhea," often with slight cyanosis, occurring in the absence of clinically demonstrable pulmonary consolidation in its early phases, with rapidly increasing fever and without x-ray evidence of atelectasis. Such patients do not have obvious heart

failure. We have seen prompt, though transient, benefit follow the administration of 6 per cent acacia solution and of transfusion of blood, both of which increase the circulating volume of blood by increasing the colloid osmotic pressure of the plasma and withdrawing water from the tissues. We have also found consultants reluctant to make a diagnosis of pulmonary edema at the onset of this usually fatal syndrome but autopsy (which has not often been obtainable in patients dying of extreme thyrotoxicosis) has usually revealed gross pulmonary edema in them, in the experience of pathologists with whom the subject has been discussed as well as in our own experience. Such a case has recently been commented on by Collier and Maddock (10). We are confident that we have initiated or hastened a fatal outcome in such patients by attempting to meet the usually accepted requirements for a large fluid intake particularly in febrile reactions. The mechanism of fever production itself is not clear in this situation any more than is its rapid onset in atelectasis and in surgical patients whose intra-abdominal and intrathoracic tension is suddenly increased by a too successful effort to close large ventral hernias without first reducing body weight. In all these cases, one is tempted to speculate that the *rapidity* with which vital capacity is diminished and presumably the total functioning area of alveolar epithelium is reduced, is perhaps through interference with the vaporization of water related to the onset of fever.

We have also been concerned with the likelihood that there is edema of the brain in thyroid crisis. In 1932 the similarity between the clinical course of patients with severe cerebral injuries and those in thyroid crisis seemed so suggestive that we began to use 50 per cent glucose intravenously immediately after operation in poor risk patients (with a daily total fluid intake not usually exceeding 2500 c.cm.) in an effort to forestall severe postoperative reactions. We were very much gratified with the result and consistently observed less circulatory and febrile reaction than we would have with confidence counted on in patients so severely thyrotoxic. We followed that plan until the appearance of

Frazier's advocacy of 10 per cent glucose for its effect in combatting the depleted glycogen reserves of the liver. Frazier used glucose in concentration of 10 per cent. We somewhat sheepishly concluded that our own patients had benefited merely from the liver sparing effects of the glucose molecule. The era of large fluid intakes then succeeded, and the hopefulness of those—of whom the author was one—(2) who found further evidence of impaired liver function in thyrotoxicosis led also to efforts to get as much glucose as possible into the patient in the belief that the glycogen of the liver could thus be restored. Fluid intakes up to 5000 cubic centimeters daily by all available routes, were freely advised with, as we believe often harmful results. More recent studies by a number of authors have indicated that there is no clear correlation between impaired liver function and the severity of the hyperthyroid reaction to operation and vice versa. In other words, impaired liver function is a "sideshow" and not the "main show." The occurrence of a phase of rising pulse pressure and fever followed by a phase of falling pressure and vasomotor collapse has long made us think that damage to nervous centers by whatever combination of edema, anoxemia, and acidosis is the essential and irreversible lethal process. Few authors today consider liver failure to be the cause of death in thyroid crisis. It is less widely recognized that large fluid intakes *per se* cause further depletion of liver glycogen (14) and that the mere administration of glucose does not actually cause restoration of liver glycogen.

These observations have renewed our interest in the question of edema of the brain. Autopsy material is scanty but Diamond has reported such pathological observations on 2 patients dying in thyroid crisis and Wolf records the experimental production of cerebral edema on the basis of lowered arteriovenous difference in oxygen content of the cerebral circulation. As noted, such a decreased difference in oxygenation of arterial and venous blood in the peripheral circulation has been demonstrated in thyrotoxicosis. For the past year we have resumed the prophylactic use of hypertonic solutions intraven-

ously and the limitation of total daily fluid intake to quantities between 2,000 and 3,000 cubic centimeters in severely hyperthyroid patients, particularly in the first 48 hours after operation. According to the criteria of Collier and Maddock this might be considered a dehydration regimen but we feel that the plan has merit. We have usually given 100 cubic centimeters of 50 per cent glucose intravenously twice daily on the day of operation and once on the first postoperative day. Hypodermoclysis of 1,000 to 1,500 cubic centimeters of mildly hypotonic glucose solution (2.5 to 5 per cent) is given following operation and the ingestion (or nasal catheter feeding) of such carbohydrate containing fluids as fruit juices and carbonated beverages, together with water, to an additional amount of 1,000 to 1,500 cubic centimeters of oral intake is planned for the day of operation. On the first postoperative day the oral intake usually suffices to make up the total intake. We make no effort to meet the total caloric requirement of these patients and have no objection to the combustion of their body fat during this period (with the precaution to be mentioned), since it is a much more concentrated source of energy than any with which we can provide them. In order to differentiate between the effect of hypertonicity of the concentrated glucose solution and the metabolic effects of the glucose molecule, *per se*, we have in the past year used 50 per cent sorbitol<sup>1</sup> intravenously in a few cases and find it quite as effective thus far in minimizing the severity of the postoperative reaction. It will be most interesting to observe the effect of transfusions of separated plasma in this situation, especially if concentrated preparations are used. Sufficient glucose must be given by other routes, however, to ensure that clinical acidosis does not occur, as unpublished studies (3) on the

carbon dioxide combining power of the plasma and the excretion of total and organic acids of the urine strongly support the view that acidosis is an important feature of hyperthyroidism. These are in all probability ketone acids, since Somogyi has recently demonstrated severe cases of ketonemia in certain hyperthyroid patients.

#### SUMMARY

We believe that currently accepted figures for desirable fluid intake in surgical patients, especially for those with hyperthyroidism, will be revised downward.

All the mechanisms whose derangement in hyperthyroidism is partly understood seem to operate in a way to favor water retention by the tissues during exacerbations. Pulmonary and cerebral edema are apparently of frequent occurrence in crisis.

We have returned, with satisfaction, to a regimen of limitation of fluid intake and the use of hypertonic solutions intravenously in severely thyrotoxic patients.

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<sup>1</sup>Sorbitol supplied through the kindness of the Abbott Laboratories.

# PRIMARY AND SECONDARY NEURILEMMOMA OF BONE

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**A**LTHOUGH the Registry of Bone Sarcoma has made provision in its newer classification for a wide variety of both benign and malignant tumors of bone and bone marrow no provision has been made for the study of neurogenic tumors occurring in bone.

That nerve sheath tumors frequently originate in bone and periosteum is well attested by occasional communications appearing in the literature. Indeed Geschickter devotes much space to a consideration of malignant neurogenic tumors and to the clinical and histological differentiation from other forms of fibrosarcoma.

There is a form of nerve sheath tumor whose specificity is assured by a distinctive histological appearance and clinical behavior which unfortunately is referred to by a bewildering variety of names indicating a diversity of opinion as to its histogenesis. Such a tumor has been described principally in the soft tissues of the body in direct continuity with peripheral or visceral nerves and has been termed peripheral neuroma, peripheral neuroma, neurofibroma, perineural fibrosarcoma, schwannoma and more latterly by Stout as a neurilemmoma.

In spite of an extensive survey of the literature dealing with this condition there has been only a single reference to the undoubted occurrence of this tumor in bone and that a brief case report by Gross, Bailey and Jacob. These authors described a tumor involving the mid shaft of the humerus in a 37 year old female with symptoms of 3 years duration. The tumor was soft solid, and the x ray appearance had been cystic. Diagnosis was made after microscopic examination of the excised specimen and the illustrations leave no doubt that this is a typical neurilemmoma, although the authors designated it as a neurofibroma.

Peers described a cystic tumor of 1 years duration located in the mid-shaft of the ulna in a 55 year old male and referred to it as a perineural fibrosarcoma. Although the photomicrographs are not absolutely conclusive they indicate in conjunction with his microscopic descriptions, that his tumor would now be classified as a neurilemmoma. Peers described whorl-like fibroblastic areas with palisading of the nuclei but also described tumor giant cells and foam cells containing doubly refractile lipid. Amputation was performed in the belief that the tumor was malignant. Twenty months following amputation the patient was free of symptoms. The diagnosis of neurogenic sarcoma in Peers case is open to serious question, as the author himself indicates.

It is most important in this connection to rectify an erroneous concept concerning the clinicopathological distinction of benign from malignant neurogenic tumors of bone. The concept is prevalent that once a neurogenic tumor invades bone, it is undoubtedly highly malignant and the possibility of cure is practically nil. Such a generalization is fallacious and will often lead to needless sacrifice of an extremity or to improper prognostication. Both of the tumors herein reported showed extensive bone destruction yet were undoubtedly benign. This is not intended to imply that malignant neurogenic sarcomas of bone do not occur. Every case must be decided on its own merits. Mere bone invasion by a neurogenic tumor is *per se* inadequate to insure the diagnosis of malignancy.

Perhaps the most comprehensive of the scattered references to the specific nerve sheath tumor is that of Stout who reported 52 tumors in peripheral locations and collected 194 authentic cases from the literature. Stout gives Verocay credit for having been the first author who adequately described the tumor and distinguished it from other neurogenic tumors. In Stout's combined series of 246 cases there was no single instance of the

From the Pathological Laboratories and Orthopedic Service of the Hospital for Paralyzed and Crippled, Philip D. Wilson, Jr., Medical Director.

occurrence of the tumor in bone. He further found stigmas of von Recklinghausen's disease in 18 per cent of 50 cases and believed that the co-existence of neurilemmoma and von Recklinghausen's disease might have been higher if the stigmas had been more carefully noted. Frequently a few pigmented cutaneous areas are the only outward manifestation of von Recklinghausen's disease. In his analysis, many of the tumors involved the extremities and almost all of these occurred on the flexor aspects of the extremities where the larger nerve trunks were present. Their localization was concentrated near the elbow, wrist, and knee. The ankle and hand were also occasionally involved. Clinically, the diagnosis was rarely made before operation, the tumor usually being classified a cyst, fibroma or, if it involved the hand, a ganglion. Stout found a number of such tumors involving the neck, face, scalp, trunk, eye and orbit, the upper respiratory tract and 35 cases involving the stomach. Within the thorax, neurilemmomas have been reported as occurring in the posterior mediastinum.

#### PATHOLOGY

More complete descriptions are to be found in general treatises. The tumor grossly is encapsulated, the capsule being formed by the epineural sheath and is attached to a nerve which may be so small as to be overlooked by the surgeon. The shape is rounded or fusiform. The largest tumor in Stout's series was 6 centimeters in diameter. The tumors are always slow growing, frequently soft and fluctuant, and have a pink to gray appearance. Often they are extremely vascular.

Stout, following Antoni, distinguished two types of tissue called for sake of simplicity, types A and B. Type A tissue is extremely specific in its appearance. The nuclei have a characteristic orientation about thin wire-like fibrils which is described as palisade formation. Type B tissue consists of a loose reticular arrangement of cells and fibrils in haphazard formation. The fibrils are often widely separated about microcystic spaces. The type B tissue is often extremely vascular and sometimes presents an angiomatoid appearance resembling fibro-angioma. Transi-

tions from A to B types exist throughout the tumor. An isolated unit of type A tissue is often referred to as a Verocay body. The presence of occasional foam cells such as are observed in fibroblastoma of the spinal cord and nerve sheath does not exclude the diagnosis of neurilemmoma although Stout found them only exceptionally in his tumors.

#### SYMPTOMS

In Gross' case, the symptoms were merely the presence of a painless mass over the middle of the left humerus of 3 years' duration. X-ray disclosed a cystic lesion involving the medulla and cortex. There was no evidence of generalized neurofibromatosis. In our first case 5 pathological fractures of the ulna had occurred over a period of 8 years before the patient consented to a resection of the tumor. Pain was not a symptom, however. In our second case painful pressure symptoms preceded the discovery of the tumor by 2½ years. The tumor originated from the fifth lumbar nerve within the neural canal and filled a wide excavation of the upper sacrum. Origin of the tumor in the first case was probably from an intracortical nerve. In this connection, it would seem advisable to review the existing concepts concerning the nerve supply to bone.

#### THE NERVE SUPPLY TO BONE

The absence of sizable nerve trunks leading into bone together with the well known relative analgesia of osseous tissue, has created a prevalent concept that bone is without nerve supply. This concept is erroneous. Nerve tissue has been repeatedly observed to be present more or less constantly in both the compact and cancellous bone of man.

Among the earlier histologists, Luschka, Kobelt, Engel, Beck, and Kolliker, all observed and recorded the presence of both a cerebrospinal and a sympathetic nerve supply to the bones of the extremities, vertebrae and skull. Kolliker, writing in 1852, gave a detailed description of the nerves of the osseous system, which he observed as being derived both from the richly innervated periosteum and as one or more minute trunks accompanying the nutrient vessels.



More recently Stohr writing in Mollen dorff's comprehensive handbook, noted the presence of these 2 sources of nerve supply to bone and illustrated a fine nerve trunk passing through bony tissue. According to Stohr the periosteum is abundantly supplied with nerves. From these minute fibers enter through Volkmann's canals into the underlying bone. Ramifications and anastomoses are scanty and no definite nerve endings have been consistently identified. It has been suggested that they are gradually attenuated and may terminate as free extremities. Many now has described these "free endings" in connective tissue wherein the nerve fiber first loses its myelin and then being accompanied only by Schwann's nuclei breaks up into thin terminal threads.

The nerves accompanying the larger blood vessels to the bones are small and usually can be identified as a ramifying plexus about these vessels. Definite independent nerve trunks, while uncommon, have been observed. These nerves are largely of autonomic origin. No definite nerve endings from this source are observed in the medullary tissues. Any of the neoplasms derived from peripheral nerve fibers therefore may conceivably arise from these nerves in bone.

#### CASE HISTORIES

**CASE K. S., male aged 37 years.** Diagnosis primary neurilemmoma arising in ulnar shaft, right ulna, duration 8 years.

In November 1930 following mild trauma the patient sustained a pathological fracture through the shaft of the right ulna. Prior to this time the arm had been symptom-free. X-ray examination revealed the fracture through circumscribed area of bone destruction which was considered to be solitary bone cyst. Healing in cast was uneventful.

During the course of the next 7 years the right ulna was refractured four times through the same site. Upon reduction and cast immobilization, the fracture, bad, in each instance healed in approximately normal time. Following the initial fracture,

firm, fixed, non-tender mass was noted on the ulnar shaft at the fracture site. The mass had gradually increased in size with each additional injury. Except for moderate weakness and ache on prolonged use, the forearm was symptom-free between episodes of fracture.

The patient as first seen at the Hospital for Ruptured and Crippled September 7, 1939, after having fractured the ulna for the fifth time. A firm

mass of bony hardness was present over the mid shaft of the right ulna. Tenderness to pressure was noted, and slight lateral motion as present, causing pain. Wrist and elbow motions were normal except for degrees of limitation of forearm supination. Moderate soft tissue atrophy of the extremity is present. Regional lymph nodes are normal. Examination of the osseous system elsewhere is negative. General examination revealed no stigmas of von Recklinghausen disease and routine laboratory examinations were not contributory. One sister died of a brain tumor of undetermined type. The family history is otherwise negative.

X-ray examination showed pathological fracture through an area of multilocular cystic change in the middle of the ulna shaft. The cystic area had expanded the anterior cortex of the ulna to a marked degree, and had completely eroded the lateral cortex, leaving an incomplete thin cystic shell of cortical bone.

On September 8, 1939, the forearm was explored under tourniquet hemostasis. Upon exposure of the ulna, firm, fusiform enlargement as encountered, measuring by 4 centimeters. The periosteum is intact over the anterior medial, and posterior surfaces. On the lateral surface the bone and overlying periosteum were perforated by tumor tissue which extended into surrounding muscle. Nerves could be identified passing into the tumor mass.

The entire tumor was dissected free from the surrounding tissues and resected together with 1 1/2 centimeter of ulnar shaft on either side. The 6 centimeter defect in the ulna was bridged with a mass of tibial bone graft. The wound was closed without drainage and cast as pyrexia. Convalescence uneventful and there has been no evidence of recurrence to date.

Gross pathological examination of the tumor showed it to be soft, hemorrhagic, and of irregular consistency. Some areas were almost gelatinous while others are gritty. The tumor appeared to rise from and to grow out of the shaft of the ulna. Microscopic examination revealed typical neurilemmoma, and the diagnosis as confirmed by Stout, Foot, and Symmers.

**CASE S. Mac L., female, aged 41 years.** Diagnosis secondary neurilemmoma arising from dorsal root of fifth lumbar nerve right thigh and lower leg, duration, 3 years.

Symptoms started in the summer of 1936 with onset of pain in the right leg and buttock. There was no history of preceding injury. The pain first appeared after patient had stood several hours on hard, uneven surface. A cramp-like pain in the calf muscles as most severe at the onset and gradually extended throughout the entire posterior leg from buttock to foot. The pain was continuous and required sedatives at night.

On October 8, 1939, the patient first attended the low back clinic at the Hospital for Ruptured and Crippled. She had received treatment almost continuously from the time of onset of pain. There



Fig 1

Fig 2

Fig 3 a and b

Fig 1 Neurilemmoma mid shaft of right ulna, Case 1, July 18, 1932

Fig 2 Roentgenogram of Case 1, taken May 21, 1935

Fig 3 a and b, Roentgenogram of Case 1 taken September 17, 1939, following a spontaneous pathological fracture through the site of disease

relief. Injections, physiotherapy, corset supports, osteopathy, and a series of 10 artificial fever treatments had been of no avail. Roentgenograms of the low back made at another hospital in 1937 were considered negative.

Examination showed a small woman, standing erect, with good posture and without a list. Leg lengths were equal. Straight leg raising was limited on the right. Forward bending was moderately limited. Sacro iliac tests were negative. Right Ober sign was positive. There was tenderness to pressure in the right ilio lumbar angle which extended to the right sacrosciatic notch.

Neurological examination revealed an absent right Achilles reflex. All other tendon reflexes were normal. Sensation to pin and light touch was diminished over the dorsal aspect of the right calf and foot. No muscular atrophy was present. General examination was negative.

Laboratory findings were non contributory with the exception of a serum alkaline phosphatase of 150 Bodansky units. Spinal fluid examination was negative.

The patient had undergone a thyroidectomy for toxic goiter several years prior to her present illness. In addition, several small tumors had been recently removed from the subcutaneous tissue of the right leg. These had been diagnosed<sup>1</sup> as benign fibro-

<sup>1</sup>By Dr N. C. Foot.



Fig 4 Drawing of gross specimen in Case 1 which shows the resected portion of the shaft of the ulna with the tumor occupying the medullary canal and the lateral subperiosteal area. The pathological fracture can be seen in the illustration.



Fig. 5 Photomicrograph through an area of the tumor Case Low power showing type A tissue with characteristic nuclear palisading



Fig. 6 Photomicrograph through another area of tumor Case Low power showing type B tissue



Fig. 7 Roentgenogram of the sacrum in Case showing an irregular destructive bony defect occupying portion of the middle and right upper sacrum

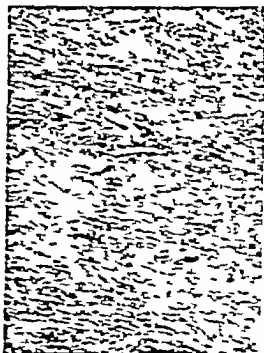


Fig. 8 Photomicrograph of section of the tumor removed from Case Low power type B tissue



Fig 9 Same case, low power, characteristic type A tissue



Fig 10 Same case, low power, ligamentum flavum on right invaded by type B tissue on left

angiomas and re examination confirmed that diagnosis. These tumors were seemingly unrelated to the present disease.

X-ray examination showed a large irregular bony defect present in the right side of the upper two sacral segments. Accordingly, admission was advised.

Two aspiration biopsies failed to establish the diagnosis and on November 24, 1939, an open biopsy was done. On section the tissue was a typical neurilemmoma.

On December 8, 1939, excision of the tumor was performed. A right hemilaminectomy of the fourth and fifth lumbar vertebrae and upper right sacrum was done, exposing the tumor, which was a multilobular, largely circumscribed mass about 4 by 6 centimeters, although in one area it had invaded the ligamentum flavum. A large, irregular, smooth walled cavity of corresponding size was present in the right sacral wing extending laterally to the right sacral crest and medially across the midline. The cavity was filled with hemorrhagic, gelatinous tumor tissue through which the upper three right sacral nerves passed. The tumor was removed piecemeal, it being necessary to sacrifice the second sacral nerve root.

The patient has experienced an uneventful convalescence and 2 months following removal has been able to resume her normal activities. Oc-

casional momentary lightning-pains down the right leg in association with mild hyperesthesia over the posterior thigh and calf comprise her only symptoms.

Microscopically, the tumor was a typical neurilemmoma which was locally invasive, confirming that observation at operation.

Our Case 1 is strikingly similar to Gross' and Peers' cases in anatomical and x-ray appearance. Both involved the mid-shaft region of the bone replacing portions of cortex and medullary cavity. Gross' tumor was removed by local excision, whereas our tumor was treated by resection of a portion of the ulna. Finger-like processes of tumor tissue extended into the cortical bone in such a fashion as to leave doubt that simple excision would have proved adequate.

Our Case 2 was non-encapsulated and invaded the bony sacrum indicating that occasionally the tumor may be locally invasive. Indeed, it even infiltrated the ligamentum flavum. Because of its location, complete removal was not possible, hence recurrence is anticipated.



Fig. 5. Photomicrograph through an area of the tumor Case 1. Low power showing type A tissue with characteristic nuclear palisading.



Fig. 6. Photomicrograph through another area of tumor Case 1. Low power showing type B tissue.



Fig. 7. Roentgenogram of the sacrum in Case 1 showing an irregular destructive bony defect occupying part of the middle and right upper sacrum.

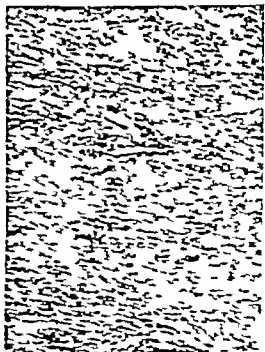


Fig. 8. Photomicrograph of a section of the tumor removed from Case 1. Low power type B tissue.



## A COMPARISON OF THE IRVING AND POMFROY METHODS OF TUBAL STERILIZATION

FRANCES HILL FOX, M.D. Boston, Massachusetts

SINCE 1850 many different operations for sterilization have been performed on the fallopian tubes in an attempt to find a technique that would prove to be 100 per cent successful. First simple ligation was tried, then double ligation with section of the tube between the ligatures. Various methods have been reported of burying the distal portion of the cut tube either in the mesosalpinx or uterine musculature. The most popular techniques in the past 20 years have been the Madlener, the Pomeroy also known as Pomeroy-Bishop or Pomeroy-Lull and the wedge-shaped excision of the tubes, including the cornua.

The Pomeroy technique consists of picking up a loop of the middle portion of the tube

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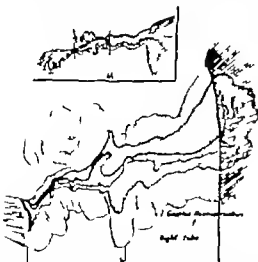


Fig. Graphic reconstruction of part of the right fallopian tube from case of Pomeroy sterilization showing the connection by shaw formation between the fomen and the peritoneal cavity. X60. a, The level of section shown in photomicrograph Figure 3. b, represents Figure 3. c, represents Figure 4. The arrow shown in Figure 3 represents the point of ligation of the tube. The time of operation. The block of tissue studied as just proximal to this point.

ligating it with an absorbable suture and then resecting the loop. Lull reported 223 cases of sterilization by this method with no known subsequent pregnancies, although he had a follow-up of only 69 per cent of his cases. Bishop (2) and Bishop and Nelms (1) report from the Brooklyn Hospital 319 cases of successful sterilization by the Pomeroy method. Lull reported one case of ectopic pregnancy in the distal portion of the tube following a Pomeroy sterilization.

There is one patient (G O) who entered the Boston Lying-in Hospital for delivery who gave a history of having had a sterilization operation performed the year before in a small hospital in Texas. A cesarean section was performed and a bilateral excision of the tubes with a wedge-shaped resection of the cornua was done at our Hospital. Both tubes showed a thinned-out portion approximately 1.5 inches from the cornua and about 1.5 inches long from the site of previous ligation. No account of the operation could be obtained from the hospital, or the doctor in Texas, but it was thought to be a Pomeroy operation or a partial tubal resection with subsequent pregnancy.

Dr. F. S. Kellogg tells me of a patient of his (H J) with a Pomeroy sterilization in 1932 followed by a pregnancy occurring 1 year later. There is one case (A H) in the Boston Lying-in Hospital records of failure to sterilize by this operation. This patient who had rheumatic heart disease had a cesarean section and Pomeroy sterilization in 1933. The following year she returned 4 months pregnant, and had an abdominal hysterotomy and resection of the right tube well into the cornua of the uterus and excision of the proximal portion of the left tube including the uterine cornua. The right tube was studied microscopically and found to be normal with the exception of an area in the thinned out fibrous portion of the tube just proximal to the point



Fig 2 Cross section of the right fallopian tube from a case of Pomeroy sterilization The position of this section is represented in Figure 1 by line *a* Tubal lumen almost normal in size and shape Hematoxylin and eosin stain  $\times 75$



Fig 3 Cross section of the right fallopian tube from a case of Pomeroy sterilization The position of this section is represented in Figure 1 by line *b* Tubal lumen greatly reduced and tubal wall very thin and lying near peritoneal surface of tube Hematoxylin and eosin stain  $\times 75$

of previous ligation Serial microscopic sections of this tissue were studied and a graphic reconstruction made (Fig 1)<sup>1</sup> Photomicrographs of representative sections are shown in Figures 2, 3, and 4 Here can be clearly demonstrated a small epithelium-lined sinus open to the peritoneal cavity and continuous with the tubal lumen Through this sinus the ovum might have gained entrance into the fallopian tube Microscopic study of the left tube shows a similar sinus connecting the peritoneal cavity and the lumen of the fallopian tube Photomicrographs of representative sections of this block of tissue are shown in Figures 5, 6, and 7

The Madlener technique consists of lifting up a loop of the fallopian tube at about its middle point and crushing it with a clamp The clamp is removed and replaced by a ligature of non-absorbable material Madlener, in 1919, reported 89 cases of successful sterilization by this method Von Graff, in bibliography in 1939, reports 304 cases of sterilization by the Madlener technique with only one subsequent pregnancy He has made a study of the literature since 1919 and finds 3,975 cases reported of sterilization by the Madlener

technique with only 18 failures Thus with his own cases he reports a total of 4,279 cases with 19, or 0.44 per cent failures

In the 21 years from 1916 to 1937, there have been 645 operations for sterilization performed in the Boston Lying-in Hospital These were done by the following methods Irving, 432, hysterectomy, 93, Pomeroy, 50, wedge-shaped excision of tubes at the cornua, 50, oophorectomy, 6, salpingectomy, 5, defundation of the uterus, 2, ligation of tubes, 2, and unilateral Irving combined with one of the other above methods, 5 It is interesting that of these patients 388, or 60.2 per cent,



Fig 4 Cross section of the right fallopian tube from a case of Pomeroy sterilization The position of this section is represented in Figure 1 by line *c* Tubal lumen open to the peritoneal cavity Tubal wall consists mostly of mucosa with a small amount of connective tissue surrounding it Hematoxylin and eosin stain  $\times 75$

<sup>1</sup>Method of graphic reconstruction Serial microscopic sections were studied and camera lucida tracings made on thin translucent manifold bond paper Orientation of these tracings was done by piling them one on top of the other on a table possessing a ground-glass top illuminated from below Permanent orienting lines intersecting at right angles were then successively drawn on each tracing starting with the lowest A theoretical plane of section at a right angle to the actual plane of section was chosen The structures of the individual sections lying in this theoretical plane were plotted on graph paper, the horizontal orienting line being used as a base line.





Fig. 5. Cross section of left fallopian tube from case of Pomeroy sterilization. This is from same case used in Figures 2, 3, and 4 but the other tube. This section is through the hole tube and surrounding scar tissue. Closed tubal lumen and thick tubal wall are seen in the lower right corner. Hematoxylin and eosin stain.  $\times 8$ .



Fig. 6. Cross section of the left fallopian tube from case of Pomeroy sterilization. This is from the same case used in Figures 2, 3, and 4 but the other tube. The then called tubal lumen is a small mass opening from it into the peritoneal cavity is seen in the lower right corner. Hematoxylin and eosin stain.  $\times 8$ .

were Roman Catholic 178 or 27.6 per cent, were Protestant 68 or 10.5 per cent, were Jewish and 11 or 1.7 per cent, were Greek Orthodox.

The medical indications for sterilization were as follows: rheumatic heart disease 208, previous cesarean sections, 152, chronic ne-

phritis, 58, pulmonary tuberculosis, 43, diseases contra indicating future pregnancies, 42, toxemia, 23, hypertension 23, relaxed pelvic floor 22, deformities or diseases of the pelvic soft tissues, 23, abnormalities of pregnancy or labor 18, deformities or diseases of the bones, 17 and mental deficiency 17.

By the Irving method of sterilization one horn of the uterus is drawn into the abdominal wound. The tube is picked up by a bite of a clamp and traced down to its fimbriated extremity to prevent any error in identification between it and the round ligament. One and one half inches from the cornual insertion a ligature of No. 1 chromic catgut is passed through the mesosalpinx and tied. Just proximal to this a double suture ligature of the same material mounted on a half curved round pointed needle knotted about 3 inches from the free ends is tied about the tube. This suture ligates the tube proximally and serves as a tractor in the steps which are to follow (Fig. 8). The mesosalpinx is clamped with two fine pointed hemostats and the tube is cut free. The mesosalpinx is tied with a No. 0 chromic catgut ligature (Fig. 9). A stab wound is made into the muscularis at the base of the proximal end of the tube. A sharp pointed hemostat is plunged into the wall of



Fig. 7. Cross section of the left fallopian tube from case of Pomeroy sterilization. This is from the same case used in Figures 5, and 6 but the other tube. The tubal lumen opens by side sinus into the peritoneal cavity is seen in the lower right corner. Hematoxylin and eosin stain.  $\times 8$ .

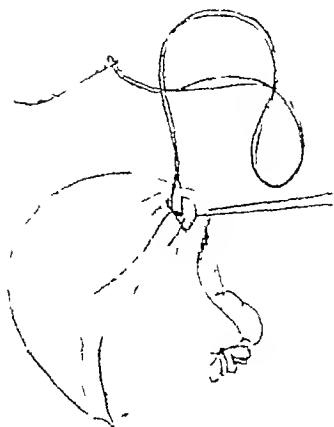


Fig 8

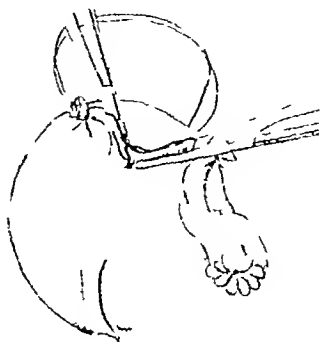


Fig 9



Fig 10

Fig 8 First stage of sterilization operation by the Irving method. A ligature of No. 1 chromic catgut is passed through the mesosalpinx and tied. Proximal to this a double suture ligature is tied about the tube.

Fig 9 Second stage. The mesosalpinx is clamped with

two fine pointed hemostats and then the tube is cut free.

Fig 10 Third stage. Irving method. A stab wound is made into the muscularis and a hemostat is plunged into the wall of the uterus through this wound and the point is spread, thus making a pit in the uterine wall.

the uterus through this stab wound as far as its lock and the point spread thus making a pit in the uterine wall (Fig 10). A grooved director is passed into this pit as far as it will go and the half-curved needle on a needle holder is passed along the director into the extreme depth of the pit and brought out on the surface of the uterus (Fig 11). The

director is then removed and traction on the suture ligature causes the tube to enter the pit in the uterine wall for a distance of approximately three-quarters of an inch (Fig 12). One strand of the double suture ligature is cut and a cross stitch is made in the superficial portion of the uterine wall and the free ends are tied together, thus anchoring the tube in the depths of the pit. The small wound at the point of entry of the tube is closed with a figure eight suture of No. 1 chromic catgut, thus completing the operation (Fig 13). The

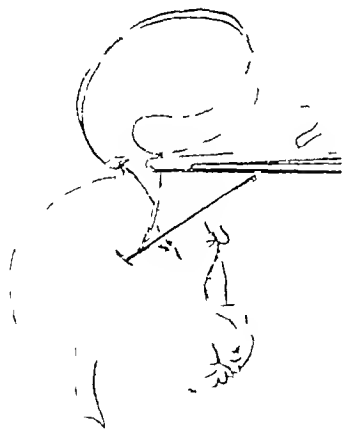


Fig 11



Fig 12



Fig 13

Fig 11 Fourth stage of sterilization operation by the Irving method. A grooved director is passed into the pit as far as it will go and a half curved needle is passed along the director and brought out on the surface of the uterus.

Fig 12 Fifth stage of sterilization operation by the

Irving method. Traction on the suture ligature causes the tube to enter the pit in the uterine wall for a distance of approximately three-quarters of an inch.

Fig 13 Sixth stage of sterilization operation by the Irving method. The tube is anchored in the uterine wall.

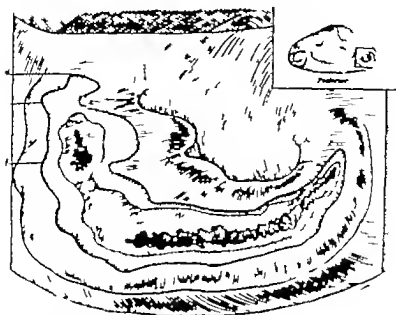


Fig. 4. Graphic reconstruction of right cornu of uterus from case of Irving sterilization. Viewed from above, the anterior surface of the uterus lying to the right. The reconstruction as made at each plane as to include the corners. The cross hatched area at the upper left represents the scar tissue in the uterine wall on the cut surface of the block of tissue at the point where the tube is buried in the uterine wall. *d*, Represents the position of the section seen in photomicrograph Figure 5. *e*, represents Figure 6. *f* represents Figure 7. Inset shows the position of the reconstructed block in relation to the uterus.

distal end of the tube is left free in the peritoneal cavity. The same procedure is repeated on the other side.

We have studied the uterus and tubes from a patient (G J) who in 1928 had a sterilization operation performed by the Irving tech-



Fig. 5. This photomicrographic section as taken from case of Irving sterilization and illustrates the scar tissue at the point where the cut end of the tube is buried in the uterine wall. The position of this section is represented in Figure 4 by line *d*. Hematoxylin and eosin stain. X 7.



Fig. 6. This section as taken from case of Irving sterilization and shows the fallopian tube lying along the surface of the uterus near the point where the tube is buried. The lumen is completely closed and fibrosed. The position of this section is represented in Figure 4 by line *e*. Hematoxylin and eosin stain. X 6.

nique Eight years later a supracervical hysterectomy and bilateral salpingo-oophorectomy were done because of fibroid tumors. The right tube was sectioned and these serial sections have been studied and a graphic reconstruction made (Fig 14). This shows the way the tube curves and is finally buried in the uterine muscle, its lumen is patent except for that portion adjacent to the uterine muscle where it merges with the scar tissue formed at the site of incision. Photomicrographs of three representative sections are shown in Figures 15, 16, and 17.

Of the 432 cases in which sterilization was done by the Irving technique, we have found no instances of subsequent pregnancy. We have not attempted to communicate by letter or interview all these patients, but feel confident that in case of a pregnancy following sterilization, the patient would communicate with us. There was one patient (H K) who, because of rheumatic heart disease, was sterilized by the Irving technique in December, 1927. She was re-admitted in November of the following year because she thought she was pregnant. She gave a history of missing her June menstrual period, then having normal periods in July and August. Her September period lasted 7 days and was followed by a free interval of 12 days after which she began to have a scanty, brownish discharge which continued until 2 days before admission. She had noted some enlargement of her abdomen. Physical examination confirmed the diagnosis of rheumatic heart disease. By rectal examination a mass was felt on both sides of the uterus and the diagnosis of uterine fibroids was made. She refused operation and was discharged. No Aschheim-Zondek test was made.

There is a case of failure to sterilize by operation on the fallopian tubes which is of interest because the technique rather than the method was at fault. This patient, (H K) because of a small pelvis, was delivered by cesarean section in 1928. In 1933, she had a second cesarean section and at this time was sterilized, by means of the Irving method on the left side, and the Pomeroy method on the right side where dense, fibrous adhesions were found. She returned in 1934, pregnant, at



Fig 17 This section was taken from a case of Irving sterilization and shows the normal fallopian tube lying along the surface of the uterus. This section is represented in Figure 14 by line f. Hematoxylin and eosin stain  $\times 67$ .

term, and was again delivered by cesarean section. Her right tube appeared normal and there was a corpus luteum in the right ovary. The entire right tube, the distal portion of the left tube, and a block of the uterus including the left cornu and the buried end of the left tube were excised. On pathological examination the proximal portion of the left tube, the site of the Irving sterilization, was found to be buried in the uterine musculature and the lumen was closed. The right tube was found to be entirely normal. The microscopic sections made from the tissue submitted as right tube at the time of her first attempted sterilization were then re-examined. This tissue was seen to be composed of fibrous tissue containing bundles of myometrium, which at the time of the first examination had been thought to represent the muscular wall of the tube. It is probable that at her first operation a dense, fibrous adhesion was mistaken for the tube and ligated and cut.

#### SUMMARY

The results of sterilization by the Pomeroy and the Madlener operations on the fallopian tubes have been discussed.

The Irving technique of sterilization by operation on the fallopian tubes has been described.

One case of failure to sterilize by the Pomeroy method has been shown by microscopic study to be due to re-establishment of

the tubal lumen bilaterally by the formation of sinuses opening into the peritoneal cavity.

One patient sterilized by the Irving method 12 years previously has been shown to have the tubal lumen occluded. Serial microscopic sections of this tube were studied and a graphic reconstruction made.

Of 432 operations on the fallopian tubes for the purpose of sterilization there were no failures by the Irving technique of 30 cases there was one failure by the Pomeroy technique.

I wish to express my appreciation to Dr. Frederick C. Irving for the use of his hospital records and statistics and for his work in describing and illustrating his operation on the fallopian tubes. I also wish to express my appreciation to Dr. Arthur T. Herthly for his kindness and assistance in making the photomicrographs used in this paper, also for

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# THE NERVOUS FACTOR IN TRAUMATIC SHOCK

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IN recent years traumatic shock has come to be regarded as largely, if not entirely, due to fluid loss into the tissues at the site of trauma. We are indebted chiefly to Blalock (2), and Parsons and Phemister for an awareness of the importance of this factor. Since the appearance of their work in 1930, other possible factors have been given little consideration. It was not until very recently that Slome and O'Shaughnessy published the results of what were probably the first experiments in which the rôle of the nervous system in the etiology of traumatic shock was demonstrated under carefully controlled conditions.

These investigators, after isolating the hind limb of a cat from the general circulation, leaving the principal nerves intact, perfused it from the circulation of another animal, or by means of a pump. Trauma to such a limb resulted in shock, while in control animals in which the nerves were severed, shock did not develop. Trauma consisted of twenty blows with a heavy iron rod, breaking the femur and damaging the muscles of the thigh. Transfusion in the shocked animals was found to have only a transient effect, whereas if accompanied by spinal anesthesia, benefit was more lasting. In a previous paper, O'Shaughnessy and Slome had reported that spinal anesthesia significantly delayed the onset of traumatic shock in the intact cat under chloralose anesthesia. Recently some of the work of O'Shaughnessy and Slome has been called into question by other investigators. Bell, Clark, and Cuthbertson repeated the cross-circulation experiments as described by Slome and O'Shaughnessy, and found that, although shock did occur in the experimental animals, all of the donor cats died first. They did note, however, in a number of cats under chloralose anesthesia, that shock was delayed in animals in which the traumatized limb was separated

from the body except for the femoral vessels, as compared with animals in which the major nerves to the limb were left intact. Blalock and Cressman (3) also reported unsatisfactory results from cross-circulation experiments. However, in the intact cat under chloralose anesthesia, some increase in the period of survival following trauma was observed when spinal anesthesia was also induced. These results could not be reproduced when nembutal was substituted for chloralose. These investigators reported abrupt, terminal drops in blood pressure and deaths apparently due to respiratory failure when chloralose was used.

The studies to be described were undertaken in an effort to resolve some of the contradictions surrounding this phase of the problem of experimental traumatic shock.

## METHODS

The studies were carried out entirely on cats. The anesthetics employed were nembutal in doses of 25 milligrams per kilogram, chloralose, 80 milligrams per kilogram, intrathecal procaine, 17 milligrams in 0.05 cubic centimeter of water per kilogram, and ether. Tracheotomy was done routinely and scrupulous care, particularly in those animals in which ether was used, was taken to keep the air passages free. In most experiments blood pressure was recorded continuously from a cannula in a carotid artery by means of a mercury manometer. Chlorazol fast pink (5 per cent), injected into the tubing just above the cannula in 0.5 cubic centimeter quantities every half hour, served as the anti-coagulant (8). This method was resorted to after it had become clear that the use of citrate was materially altering the course of the experiments. Body heat was maintained in every case by either an electric heating pad or a heat cradle. Rectal temperature was measured continuously. At the close of each experiment the animals were carefully killed for autopsy,

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TABLE I.—TRAUMATIC SHOCK IN THE INTACT CAT

No. cat	Weight kgm.	Anesthesia	Procedure	Course	Autonomic pathology	Final blood as per cent body weight
1		Verbalal 25 mgm per kgm	on blow to thigh Carotid arteries occluded	Blood pressure to 100 following trauma, followed by a sharp fall to 50 in few minutes. The fall was hastened by several large syringes opened.	Multiple fractures, femur	95
2		Verbalal 25 mgm per kgm	on blow to thigh Carotid arteries occluded	Blood pressure declined beginning 10 minutes after trauma, and reached 0 in 10 minutes later.	Multiple fractures, femur	
3		Verbalal 25 mgm per kgm	on blow to thigh Carotid arteries occluded	Blood pressure declined beginning 20 minutes after trauma, and reached 0, 40 minutes later.	Multiple fractures, femur	

\*Other than findings occurring regularly in shock (transmitted from right difference of the hind quarters).

and the lower quarters were separated and weighed as described by Blalock (2).

The experiments were divided into two general groups. In the first which served more or less as an orientation for the second, the course of the intact animal subjected to trauma to a hind limb was studied under various conditions. The limb was struck a number of times with a heavy round iron bar breaking one or more bones. Breaks in the skin were carefully closed.

In the second group of experiments, the effect of trauma to a perfused hind limb separated from the body except for its nerve supply was studied. In 3 experiments the circulation to the limb was isolated in a manner similar to the anemic limb preparation described by O'Shaughnessy and Slome (9). The limb was then perfused from the circulation of a heparinized donor cat, femoral artery and vein of the donor being joined to femoral artery and vein of the isolated limb by means of cannulas and rubber tubing. In 5 experiments the limb was perfused by means of a pump the procedure being a modification of that described by Slome and O'Shaughnessy (12). An incision was made in the groin just large enough to permit the insertion of a dissecting scissors. The skin was separated without loss of blood from the subcutaneous tissues and cut along a line completely encircling the thigh at the level of the greater trochanter laterally and the inferior margin of the symphysis pubis medially. The skin was then retracted and the subcutaneous tissues gathered into bundles by blunt dissec-

tion and cut between ligatures. The sciatic, femoral and obturator nerves were next isolated care being taken to preserve the vascular anastomosis. The muscles of the thigh were then separated along the fascial planes for about an inch the separation being carried as far centrally as possible and two stout ties were placed around each muscle group about 1 inch apart. Branches of the femoral vessels arising between these two points were ligated. Muscle bundles not readily separated from the femur were included in ligatures around the bone. In this way the circulation to the limb was completely and surely isolated except for flow through the femur which, in a number of experiments, was controlled by carefully stripping all muscle from the bone at the level of ligation and by plugging the medullary canal of the proximal fragment of the femur with bone wax following the trauma. A postmortem examination was performed on the animal in each instance in order to be certain that damage had not been done to the nerves and that isolation of the circulation was complete.

The limb was perfused with blood drawn from a donor cat and rendered non-coagulable by the addition of 0.4 to 0.5 milligram chloral fast pink per cubic centimeter of blood (7). The perfusion system was much reduced in size so that the blood of one cat sufficed for each experiment. It included an oxygenator filter air trap pressure by-pass arterial manometer warming coil and stromuhr. Thus blood could be supplied to the limb thoroughly oxygenated and at body temperature the per-

TABLE II—TRAUMATIC SHOCK IN THE INTACT CAT

No Sex	Weight kgm	Anesthesia	Procedure	Course	Adventitious pathology	Fluid loss in per cent body weight
15 M	3.4	Chloralose 80 mgm per kgm	30 blows to thigh Carotid pressure Chlorazol fast pink anticoagulant	Blood pressure 125 and steady $5\frac{1}{2}$ hours after trauma. Animal sacrificed	Multiple fractures of femur	2.9
16 F	2.9	Chloralose 80 mgm per kgm	30 blows to thigh Carotid pressure Chlorazol fast pink anticoagulant	Steady decline in pressure reaching 0 in 3 hours	Multiple fractures of femur	3.6
17 M	2.6	Chloralose 80 mgm per kgm	40 blows to thigh 20 blows to leg etc	Steady decline in pressure, reaching 0 in $1\frac{1}{2}$ hours	Multiple fractures of femur as well as of tibia and fibula	6.1
18 M	2.7	Chloralose 80 mgm per kgm	40 blows to thigh 20 blows to leg etc	Steady decline in pressure reaching 0 in $1\frac{3}{4}$ hours	Multiple fractures of femur as well as of tibia and fibula	2.8

fusion pressure accurately adjusted, and the flow measured

Other pertinent details of method and the sundry control procedures will be described together with the experimental results

#### RESULTS

##### *Experimental traumatic shock in intact cats*

In 3 cats the femur was broken and the thigh muscles injured by 20 blows to the thigh. Nembutal was used as the anesthetic and citrate as the anticoagulant. The results of these experiments appear in Table I. It was noted in these and subsequent experiments in which citrate was used, that when a clot occurred in the cannula, the pressure following removal of the clot was always lower by 10 to 20 millimeters mercury, and recovered only slowly. In a number of instances the artery was clamped in the absence of clot, the tubing flushed, and the pressure set at the exact level at which it had been the moment previously. When blood was readmitted to the cannula the same fall was noted. Removal of 2 to 3 cubic centimeters of blood from the vein of a control animal (a quantity in excess of that entering the cannula when pressure in the tubing is closely approximated to pressure in the artery) produced no such effect, even though repeated a number of times. It was concluded, therefore, that citrate entering the artery was responsible for the fall in blood pressure after removal of a clot from the cannula. While it is well known that citrate lowers blood pressure, many investigators

have nevertheless used citrate as the anticoagulant in the blood pressure recording system in their studies on shock, a practice which undoubtedly introduced an error into many such experiments.

In 4 animals, chloralose served as the anesthetic and chlorazol fast pink as the anticoagulant. This dye does not exert a depressor effect on blood pressure. Varying degrees of trauma were used, as is indicated in Table II, in which the results of these experiments are summarized. It was noted that more intense trauma was necessary to produce shock in the absence of citrate. The change in anesthetic could not be held accountable as will become clear later.

In 8 cats an effort was made to determine the effects of trauma when extremely light ether was used in the posttraumatic period. Four animals were lightly etherized and fixed to the animal board, by means of broad, soft restraints. In 1, a continuous blood pressure record was taken, citrate being used. In 3, blood pressures were recorded at the close of the experiment only. In all, ether and local anesthesia were used prior to cannulating the artery. The trauma consisted of 20 blows, as described, ether anesthesia being deepened during trauma to a point where there was no evidence of pain. It was greatly reduced promptly following trauma.

Shock rapidly ensued in the animal in which a continuous blood pressure record was taken. However, in the 3 remaining animals shock did not develop after many hours. Accord-



TABLE III—TRAUMATIC SHOCK IN THE INTACT CAT

No. cat	Weight, kgm.	Anesthesia	Procedure	Time	Remarks	Final time in per cent body weight
		Local ether followed by ether anesthesia	30 blows to thigh. Continuous control of pressure. Citrate anticoagulant.	Steady decline to blood pressure reaching 0 in 2 hours	Animal sacrificed	Multiple fractures of femur
1		Local ether followed by ether anesthesia	30 blows to thigh. Terminal control pressure. Citrate anticoagulant.	Blood pressure sacrificed 1 hour after trauma	Animal sacrificed	Multiple fractures of femur
2		Local ether followed by ether anesthesia	30 blows to thigh. Terminal control pressure. Citrate anticoagulant.	Blood pressure 90, 8 hours after trauma	Animal sacrificed	Multiple fractures of femur
3		Local ether followed by ether anesthesia	30 blows to thigh. Terminal control pressure. Citrate anticoagulant.	Blood pressure 90, 10 hours after trauma	Animal sacrificed	Multiple fractures of femur
4		Local ether followed by ether anesthesia	30 blows to thigh	None at day later		
5		Local ether followed by ether anesthesia	30 blows to thigh. 30 blows to leg. Terminal control pressure. Chloroform and post-punk anticoagulant.	Blood pressure 90, 1 hour later	Animal sacrificed	Multiple fractures of femur, tibia, fibula, and tarsal bones
6		Local ether followed by ether anesthesia	30 blows to thigh. 30 blows to leg. Terminal control pressure. Chloroform and post-punk anticoagulant.	Blood pressure 90, 1 hour later	Animal sacrificed	Multiple fractures of femur, tibia, fibula, and tarsal bones
7		Local ether followed by ether anesthesia	30 blows to thigh. 30 blows to leg. Terminal control pressure. Chloroform and post-punk anticoagulant.	Blood pressure 90, 1 hour later	Animal sacrificed	Multiple fractures of femur, tibia, fibula, and tarsal bones
8		Local ether followed by ether anesthesia	30 blows to thigh. 30 blows to leg. Terminal control pressure. Chloroform and post-punk anticoagulant.	Blood pressure 90, 1 hour later	Animal sacrificed	Multiple fractures of femur, tibia, fibula, and tarsal bones

ingly in the next 4 animals, more intense trauma was used. In the first, 30 blows were struck using greater force than previously, whereas in the others, both the number and force of the blows was increased.

Except for the first cat, which was permitted to survive in each instance the carotid was cannulated under ether and local anesthesia before the experiment was discontinued and the blood pressure was measured after the effects of the ether had been dissipated. The animals were then sacrificed and fluid loss determined as described.

The first animal was alive and vigorous 16 days later. The 3 remaining were still alive after many hours, in spite of the intense trauma, and very extensive fluid loss. Only one was definitely in a state of shock, whereas

in another blood pressure was quite normal in spite of a fluid loss amounting to 51 per cent of the body weight.

The results of these 8 experiments are summarized in Table III.

It appeared from this first group of experiments that animals withstood trauma to a hind limb better when under very light rather than deep anesthesia in the posttraumatic period. It was also apparent that citrate affected the posttraumatic course adversely. Lastly it was concluded that 30 blows, as described by O'Shaughnessy and Stone (9) was not a severe enough trauma to insure uniform results in experiments of this type.

Experimental traumatic shock with only the nervous factor operative. In 3 instances, cross-circulation experiments were undertaken as

described. These proved to be very unsatisfactory, the donors dying before the recipients in each case. This method of study was therefore abandoned.

*Control experiments* Ten animals were used in the perfusion experiments and controls. The control observations were made on 5 cats. In 4 animals under chloralose, the limbs were prepared as though for perfusion as described previously, the limb being denervated at the outset. Blood pressure was measured throughout this surgical procedure. In the first 2 animals, in spite of the fact that there was practically no blood loss, pressure declined markedly during the procedure, and displayed wide variations during this period. The total fall amounted to as much as 40 millimeters of mercury. However, a short period during which no manipulations were made permitted recovery.

In the first animal, when trauma was begun, it was rather surprising to note a sharp decline in blood pressure following the first several blows, since the limb had both its nerves and vascular connections with the body severed, and striking it should have been equivalent to striking the table. Accordingly, the remaining blows in this and the second animal were directed at the table, a very steep drop in pressure of as much as 45 millimeters of mercury resulting. This could be repeated, recovery always being quite prompt and maintained. Eight hours after the outset blood pressures were well above shock levels<sup>1</sup>.

In the third animal, spinal anesthesia was used in addition to the chloralose. Following the induction of spinal anesthesia, blood pressure declined from 120 to 80 millimeters of mercury. However, blood pressure remained quite stable throughout the surgical procedure of isolating the limb, showing none of the changes described in the first 2 control animals. With the preparation complete, blood pressure rose as the knee jerks returned, reaching its initial level, where it stood at the end of 5 hours.

In a fourth control animal the course was essentially as that described for the first 2, except that toward the close of the experiment

the rectal temperature was inadvertently permitted to rise to 40 degrees C. Blood pressure dropped to 50, but with the removal of the heat it began to rise slowly. This trend was in evidence as the experiment was terminated 8 hours after the outset.

Lastly, the effect of severe jarring on blood pressure of the animal under chloralose, not operated upon, was studied. Under these circumstances, it was also found possible to produce marked depression, the blood pressure being driven from 150 down to 85 over a period of 1 hour and 20 minutes, the table being struck about 500 blows during this time. However, permanent depression could not be achieved by this means, the pressure eventually recovering. A refractoriness to this type of stimulus eventually became established, severe and prolonged jarring producing little or no effect. The results of these control experiments are summarized in Table IV.

*Perfusion experiments* Five animals were used in the perfusion experiments. In 2 cats under chloralose anesthesia (80 milligrams per kilogram), a hind limb was isolated and perfused, as described, but the nerves were left intact. Over an hour after starting the perfusion, the flexion reflex, in each case, was equal on both sides. Trauma, consisting of 90 blows to the perfused limb, resulted in shock in the course of a few hours. Careful dissection, postmortem, showed the circulation of the perfused limb to be completely isolated in these and subsequent experiments.

In a third animal, 35 milligrams of chloralose per kilogram of body weight (reinforced with ether, as needed) was administered, less than half the customary dose. The animal was prepared for perfusion as described. Blood pressure stood at 145 at the time perfusion was begun. During the hour that followed certain adjustments were made that necessitated considerable manipulation of the wound. No blood loss was involved. The blood pressure fell slowly to 50 by the end of the hour. In the next hour the animal was undisturbed. Blood pressure returned to 115. Two and one-half hours after the beginning of perfusion, the flexion reflexes in both limbs were equal, and blood pressure was 115. The perfused limb showed no grossly visible edema.

<sup>1</sup>Later observations indicate that the fall of blood pressure obtained as a result of striking the cat board is accompanied by a sharp increase in ear temperature suggesting a vasodilatation.

TABLE IV.—TRAUMATIC SHOCK IN THE ISOLATED INNERVATED LIMB PREPARATION CONTROLS

Case	Weight kgm.	Anesthesia	Procedure	Course	Advantages Pathology
C <sub>1</sub> M	75	Chloralose 50 mgm. per kgm.	Limb isolated and desheathed, car- otid pressure. Chlor- alose last peak at trauma.	Initial pressure, 90. Drop during procedure to 50. No blood flow. Recovery to 70 within 10 min. Manipulation of prox- imal shunt followed by fall to 50 mm Hg. 20 blows to table accompanied by drop from 50 to 40 with prompt recovery. Some response elicited repeatedly. Pressure, 100, 8 hours after trauma. Animal sacrificed.	None
C <sub>2</sub> F		Chloralose 50 mgm. per kgm.	Limb isolated and desheathed, car- otid pressure. Chlor- alose last peak at trauma.	Initial pressure, 90. Drop during procedure to 70. No blood flow. Recovery to 70 within 10 min. Manipulation of wound followed by fall from 70 to 60. Recovery to 70. 20 blows to table accompanied by drop from 60 to 40. Prompt recovery. Pressure 100, 14 hours after trauma. Animal sacrificed.	None
C <sub>3</sub> F		Chloralose and spinal	Limb isolated and desheathed, car- otid pressure. Chlor- alose last peak at trauma.	Initial pressure, 90. Spinal anesthesia followed by fall to 50. Pressure steady at 50 throughout procedure. Knee jerk ab- sent. Recovery to 120 in 10 min. Knee jerk returned. Pres- sure 100, 3 hours after trauma. Animal sacrificed.	None
C <sub>4</sub> F		Chloralose 50 mgm. per kgm.	Limb isolated and desheathed, car- otid pressure. Chlor- alose last peak at trauma.	Initial pressure recorded 15 min following completion of prep- aration, 90. Manipulation of wound followed by fall to 50. Pressure 10, 14 hours after trauma. Rectal temperature in adversely paralyzed to reach 30°C. Pressure fell to 50. Pressure slowly recovering. Two experiments terminated, 8 hours after trauma.	None
C <sub>5</sub> M		Chloralose 50 mgm. per kgm.	Carotid pressure. Chloralose last peak accompanied in short trauma.	Initial pressure 90. 20 blows struck to table over period of 14 hours. Pressure, 85. Recovery to 120 in 10 min. 20 blows in next hour without effect.	None

Five hours had elapsed since the administra-  
tion of the anesthetic. The pupils were mark-  
edly constricted. Ether anesthesia was in-  
duced and 90 blows were delivered to the  
limb. The broken femur was exposed at once  
and the medullary canal was plugged with  
bone wax. A drop in pressure of about 5  
millimeters of mercury was noted during  
trauma, followed by recovery to the initial  
value of 115. The marked depressor response  
to jarring of the cat board seen in the control  
animals under chloralose anesthesia was ab-  
sent. The ether was greatly reduced after  
trauma, and shortly thereafter the pupils were  
again slit like. Two and one-half hours after  
trauma and 6¼ hours after the first dose of  
chloralose the blood pressure was still 115  
and the animal was still under ether analgesia.  
*Chloralose to the amount of 70 milligrams per  
kilogram of body weight was injected intra-  
venously at this time. A few minutes later  
the animal board was struck several times  
and this sent the blood pressure from 115 to  
70 but prompt recovery followed. Within 20  
minutes of the second dose of anesthesia the  
blood pressure had fallen 25 millimeters  
within 65 minutes, it had declined to 0.*

Two animals were prepared for limb per-  
fusions under spinal anesthesia, reinforced

with light ether as needed. Before observa-  
tions were begun all evidence of the spinal  
anesthesia had disappeared and flexion re-  
flexes on both sides were equal. Ether was  
given during trauma, which consisted of 90  
blows to the isolated innervated perfused  
limb. In neither animal was the marked de-  
pressor response to jarring seen. The first  
cat was rather deeply etherized previous to  
trauma. Its pressure fell from an initial value  
of 110 to 85 with anesthetization. During  
trauma there was a momentary rise of pressure  
to 110, followed by a prompt decline to 85.  
The broken femur was plugged proximally  
with bone wax and the ether discontinued, to  
be renewed only in analgesic quantities.  
Blood pressure slowly rose reaching its initial  
level within 2 hours after trauma, and remain-  
ing there for about an hour after which it  
slowly declined reaching 0 in 3¼ hours after  
trauma. In the second animal trauma was  
not begun until 3¼ hours after starting the  
perfusion. There was no evidence of edema in  
the experimental limb its nervous responses  
equaling those of the normal side. Ether was  
administered. The blood pressure varied  
little from its initial value of 115. With  
trauma there was a drop of 10 millimeters of  
mercury with immediate recovery. The femur

TABLE V—TRAUMATIC SHOCK IN THE ISOLATED INNERVATED LIMB PREPARATION

No Sex	Weight kgm	Anesthesia	Procedure	Course	Adventitious Pathology
P <sub>3</sub> M	2.5	Chloralose 80 mgm per kgm	Limb isolated and perfused. Nerves intact. 30 blows to thigh 30 blows to leg 30 blows to foot carotid pres- sure. Chlorazol fast pink anticoag- ulant	Initial blood pressure 140 Pressure to 80 during trauma Prompt recovery to 100 following trauma Steady decline to 0 in 2½ hours	Multiple fractures of femur tibia, fibula carpal bones
P <sub>4</sub> F	2.3	Chloralose 80 mgm. per kgm	Limb isolated and perfused. Nerves intact. 30 blows to thigh 30 blows to leg 30 blows to foot carotid pres- sure. Chlorazol fast pink anticoag- ulant	Initial blood pressure 100 Pressure to 60 during trauma Prompt recovery to 85 following trauma Steady decline to 0 in 3¼ hours	Multiple fractures of femur tibia, fibula carpal bones
P <sub>12</sub> F	2.2	Chloralose 35 mgm per kgm	Limb isolated and perfused. Nerves intact. 30 blows to thigh 30 blows to leg 30 blows to foot carotid pres- sure. Chlorazol fast pink anticoag- ulant	Initial pressure 115 Recovery from initial anesthetic. Ether No change in blood pressure Trauma. Pressure to 110 during trauma Ether analgesia henceforth Pressure 105 2½ hours after trauma Chloralose 70 mgm per kgm. given Prompt decline to 0 in 1 hour	Multiple fractures of femur tibia, fibula carpal bones
P <sub>13</sub> M	2.4	Spinal and ether	Limb isolated and perfused. Nerves intact. 30 blows to thigh 30 blows to leg 30 blows to foot carotid pres- sure. Chlorazol fast pink anticoag- ulant	Initial pressure 110 Ether Pressure to 85 Trauma. (Ether analgesia henceforth) Pressure 85 Recovery to 100 within 1 hour Maintained above 100 for 2 hours Slow fall to 0 in the next 2¼ hours Survival 5½ hours	Multiple fractures of femur tibia, fibula carpal bones
P <sub>14</sub> F	2.5	Spinal and ether	Limb isolated and perfused. Nerves intact. 30 blows to thigh 30 blows to leg 30 blows to foot carotid pres- sure. Chlorazol fast pink anticoag- ulant	Initial pressure 115 Ether No change in pressure Trauma. (Ether analgesia henceforth) Pressure 110 Pressure 120 5¼ hours after trauma. Animal sacrificed	Multiple fractures of femur tibia, fibula carpal bones

was plugged promptly Five and one-fourth hours later, when the experiment was terminated, the arterial pressure was 120

In these 2 animals it was noted that periods of excitement under ether analgesia almost uniformly caused a fall rather than a rise in blood pressure The results of the perfusion experiments are summarized in Table V

#### ANALYSIS OF STUDY

The argument advanced against the nervous factor in traumatic shock has been based entirely on evidence of a negative character (Blalock, 2, Parsons and Phemister, Cannon, Freedlander and Lenhart, and others) This has consisted largely of experiments in which peripheral nerves or central pathways have been interrupted without influencing the onset of shock In other experiments peripheral

nerves have been stimulated faradically without the production of shock In still others, the magnitude of fluid loss has been accepted as sufficient proof that the nervous factor was of no consequence In none of these experiments were fluid loss ruled out and the rôle of the nervous system studied independently

In those investigations of Slome and O'Shaughnessy (12), O'Shaughnessy and Slome (9), Bell, Clark, and Cuthbertson (1), and Blalock and Cressman (3) in which an effort was made to study the nervous factor under controlled conditions, the lack of agreement apparently revolves around a number of points of procedure Only the cross-circulation and not the mechanical perfusion experiments of O'Shaughnessy and Slome were repeated, in spite of the fact that the former employ an extremely difficult and unreliable

method. In addition, the degree of trauma used in these experiments was apparently not intense enough invariably to give a clear cut result. Differences in the anesthesia used probably also accounted in part, for variations. It should be noted, however, that the abrupt terminal drops in blood pressure, and deaths apparently due to respiratory failure described by Blalock and Crossman (3) in experiments in which chloralose was used were not encountered in the present study. No untoward effects ascribable to this anesthetic were seen at any time.

In the studies here recorded, an effort was made to obviate these criticisms. Trauma in many experiments was quite intense. In several experiments, anesthesia was withheld in so far as permissible. The use of citrate for continuous blood pressure recording was avoided. And finally the perfusion experiments were done by means of a very accurate and dependable mechanical system. In addition, the possible loss of blood through the fractured femur a factor not controlled by O'Shaughnessy and Slome was checked in several experiments. When all these precautions were observed, it was still possible to produce fatal shock by traumatizing a limb having only its nervous connections with the body intact.

In attempting to integrate the nervous and fluid-loss factors, Slome and O'Shaughnessy (12) ascribed the initial depressor effect following trauma to a cat a limb to fluid loss, and the subsequent fall in blood pressure, to nervous impulses arising in the traumatized area. However a marked initial depression of blood pressure was always seen in the present studies, even though the limb was being perfused and there was no fluid loss, provided the animal was under chloralose anesthesia. As has been described, striking the table was quite as effective as striking the limb in this respect and such an effect could certainly not have been mediated except through the nervous system. However since this last observation could not be reproduced in animals under ether analgesia too much weight can not be attached to it.

The conclusion drawn by O'Shaughnessy and Slome (9) that anesthesia serves to pro-

tect against shock by blocking so called nociceptive impulses arising from the traumatized area, cannot be substantiated. Though such impulses may actually be depressed, general anesthesia apparently impairs other functions sufficiently that the balance is tipped toward the other side. Venous return mediated by muscular activity may be one factor involved. In addition SeEVERS and Stormont have shown that general anesthesia in both man and animals impairs the ability to adjust to changes in blood ion concentration. In this connection it is of interest that Freeman and his co-workers reported an acidosis in animals going into shock following hemorrhage.

Although the argument throughout has concerned itself solely with that type of shock produced in the experimental animal by trauma to an extremity the observations of Taylor, Weld and Harrison are of interest as they bear upon the concept of a nervous mechanism in shock generally. These investigators reported the production of shock in dogs by distending segments of bowel, without obstruction. This was accomplished by the insertion of a distensible balloon attached to a heavy piece of rubber tubing into the bowel which was then distended by inflation of the balloon. Continuity of the intestinal passage was maintained by the tube. Shock could be prevented by the denervation of the length of bowel prior to its distention.

#### CONCLUSIONS

1. Shock can be produced in the cat by appropriate trauma to a perfused hind limb separated completely from the general circulation and communicating with the body only by means of its nerves. This can be demonstrated in the animal under chloralose anesthesia, as well as in the animal under ether analgesia in the posttraumatic period.

2. The animal under ether analgesia appears to be more resistant to shock produced by trauma to an artificially perfused innervated limb than is the more deeply anesthetized animal (under chloralose).

3. The intact animal under ether analgesia in the posttraumatic period is much more resistant to shock produced by trauma to an

extremity than is the intact animal under chloralose or nembutal anesthesia. The animal under ether analgesia is thus more resistant to the nervous and fluid loss factors combined, in experimental traumatic shock, than is the anesthetized animal.

The experiments here reported have been designed to test the reality of a nervous factor in traumatic shock and shed no light whatever upon the relative importance of this as compared with other causative factors.

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# CLINICAL SURGERY

## A NEW VALVULAR CHOLECYSTOGASTROSTOMY

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**F**OLLOWING a direct anastomosis of the gall bladder to the stomach, the biliary system is no longer protected as it was normally by the valve-like action of the sphincter of Oddi and the constricting action of the duodenal musculature. The direct interchange of contents occurring between the gastro-intestinal tract and the gall bladder may predispose to infection of the biliary tract varying from mild to very severe toxic states. Even though such extension of the inflammation may not always manifest itself clinically there are surgeons who state that cholangitis and hepatitis invariably occur after cholecystogastrostomy. Those who have observed and reported these post-operative conditions have devised methods which were to prevent them, but which were not as successful as expected. Whipple found cholangitis and hepatitis resulting from cholecystogastrostomy when this operation was combined with gastro-enterostomy preliminary to resection of the head of the pancreas. Lahey and McKinnon advocated the use of the upper portion of the jejunum for anastomosis with the gall bladder in an effort to eliminate an ascending infection of the biliary tract. To avoid a direct interchange of contents between gall bladder and jejunum, Whipple employed the type of direct cholecysto-jejunosomy originally suggested by Monprofit. Brunschwig and others employed a long loop of jejunum for cholecystenterostomy combining it with an entero-enterostomy as an additional safeguard. Wangersteen is of the opinion that the site between the gastro-intestinal tract and the gall bladder is not as important as the site of the opening which is to be adequate for drainage.

In a ray study of patients with cholecystogastrostomies, Bernhard found in at least 50 per cent of the cases a regurgitation of the biliary into the gall bladder and biliary passages. Fogelson and Bachrach reported similar findings in dogs with cholecystogastrostomies, but stated

that they could not attribute the periportal hepatitis which they saw to an ascending infection. They further noted that hypo-acidity and infection of the common duct co-existed in these animals. Zollinger experimented with two groups of dogs in which he employed two methods of cholecystogastrostomy. In one group he followed the ordinary procedure in the second group he performed his original valvular cholecystogastrostomy. At autopsy he found food particles and hair in the gall bladder and the biliary tracts only in the animals which had been subjected to ordinary cholecystogastrostomy but none whatever in the second group. In a further examination of the biliary tracts in both groups after sodium iodide injections, Zollinger observed that the intrabiliary and extrabiliary tracts were grossly dilated only in the cholecystogastrostomies which did not include a valve also, when air was injected into the stomach its prompt entrance into the biliary tree indicated again the ease with which bacteria-laden food particles may make their way into the gall bladder and biliary tract.

Turning now to actual methods of anastomosis between stomach and gall bladder which have been devised to prevent the postoperative sequele mentioned, it was Mason who first developed a procedure with that object in mind. After making a tunnel between the submucosa and muscularis of the anterior stomach wall, in the region of the antrum from lesser toward greater curvature, he drew the fundus of the gall bladder through it, and established the anastomosis with the gastric lumen. Spivack's method of valvular cholecystogastrostomy is similar to that of Mason, except that he employs a tunnel made in a horizontal direction on the antral wall. Mirizzi modified Mason's method by establishing the tunnel in the duodenal wall.

Gentile applying Coffey's principle of transplanting the ureter which depends upon the formation of a stoma by the sloughing of a transfixed suture between ureter and colon failed to produce by this method a successful anastomosis between gall bladder and stomach in his experi-

(The technique herein described was perfected in the Department of Anatomy of the University of Illinois, College of Medicine, with the aid of Dr. Otto F. Harnsperger, professor of Anatomy and head of the department. The writer wishes to express his indebtedness to Dr. Harnsperger for his invaluable aid.)

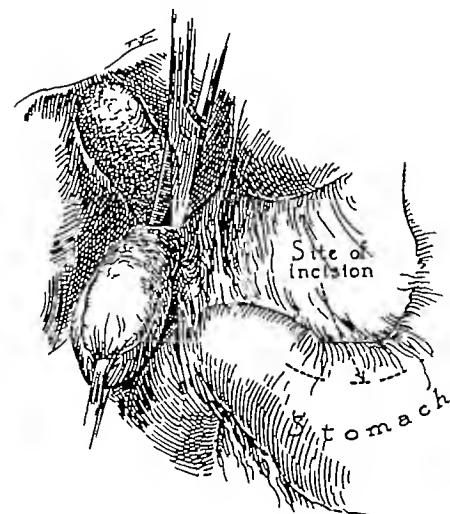


Fig 1 The gall bladder is mobilized from its liver bed by sharp dissection. The dotted line on the anterior surface of the stomach antrum indicates the site of incision and anastomosis.

Experimental animals Zollinger repeatedly stresses the fact that in order to assure a patent stoma, an opening between gall bladder and stomach must actually be established at the time of operation. Zollinger's own method of valvular cholecystogastrostomy consists of making a seromuscular incision into the stomach from lesser to greater curvature, then fixing and anastomosing the gall bladder to the stomach near the greater curvature and sewing the edges of the seromuscular gap over the body of the gall bladder by interrupted sutures. The valve-like effect of the confluence produced by this method depends upon the formation of a flap, consisting of gall bladder wall and gastric mucosa, which, when pressed against the anterior gastric wall by food entering the stomach, closes the stoma leading into the gall bladder.

Experimenting with a new mode of attack, the present writer devised a valvular cholecystogastrostomy which appears more simple and is an improvement over the preceding methods. It represents a circular or teat-like valve formed at the junction of the gall bladder and stomach which is successful in preventing the gastric contents from regurgitating into the biliary tract. The procedure of establishing such a valve is as follows:

Through either a transverse, or a Kocher type of incision of the abdominal wall the gall bladder and stomach are exposed. The gall bladder, being usually distended, easily presents itself in the

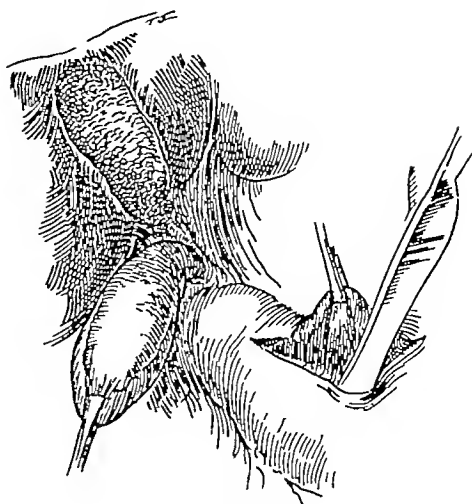


Fig 2 The seromuscular incision is made, and the herniation of gastric mucosa is increased by traction upward with an Allis forceps and by blunt stripping.

wound. The common, hepatic and pancreatic ducts are examined, and then the character of the contents of the gall bladder determined by aspiration. The presence of normal or turbid bile within the gall bladder indicates that the bile is passing freely into it, and that the anastomosis should produce a favorable result. However, when lumpid white bile is withdrawn into the syringe, surgery is not indicated, for if done it is worse than useless since it is followed by a high mortality.

The body of the gall bladder in most instances has to be dissected from its liver bed sufficiently to permit the fundus to be brought down to the anterior surface of the gastric antrum.

A slightly curved seromuscular incision about 5 centimeters long is made on the anterior surface of the antrum, parallel to and approximately 2 centimeters from the lesser curvature, as shown in Figure 1. This step permits the gastric mucosa to bulge out far enough to enable it to be grasped and pulled upward by means of an Allis forceps (Fig 2). By continued traction and careful blunt stripping at the line of submucosal cleavage between the muscularis and mucosa (Fig 2), a greater herniation of the gastric mucosa occurs. A mucosal outpouching of approximately 3 to 4 centimeters is considered sufficiently long to proceed with its attachment to the gall-bladder fundus. Sharp dissection should be avoided wherever possible in order not to cut through the mucosa. (Incidentally, this pro-





Fig. 3. A Sutures are inserted into the seromuscular coat of the posterior wall of the gall bladder about 3 centimeters from the fundus, continued through the same layers of the posterior lip of the stomach incision and temporarily left untied. B, A arrow stitch has been completed between gall-bladder fundus and part of the herniated gastric mucosa. The dotted lines represent sites of incision for opening and anastomosing the stomach.

cedure of causing a herniation of the gastric mucosa should solve the problem of approximating the biliary system and the stomach in those few cases of choledochogastrostomy or those re-

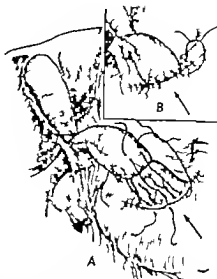


Fig. 4. A The anastomosis is completed between the gall bladder and gastric mucosa. Interrupted sutures, like those that are left untied on the posterior aspect of the anastomosis, are now placed on the anterior aspect of the junction of the two organs. B The posterior and anterior interrupted sutures have been tensioned and tied, completing the invagination of 3 to 5 centimeters of gall bladder fundus and about 4 to 5 centimeters of gastric mucosa into the lumen of the stomach. The arrows indicate the plane of section represented by diagrammatic sketches in Figure 5.

quiring choledochogastrostomy in which the stomach cannot be mobilized easily. This procedure would, of course, necessitate peritonization of the drawn out mucosal anastomosis.)

Before anastomosing the mucosal outpouching of the stomach with the fundus of the gall bladder 4 to 6 interrupted sutures are passed through the seromuscular layer of the posterior wall of the gall bladder at a point about 3.5 centimeters from the tip of the fundus and then through the seromuscular layer at the posterior edge of the stomach incision (Fig. 3, A). These posteriorly placed sutures are kept on forceps and are not tied until the anastomosis is completed. Both the fundus of the gall bladder and the apex of the protruding gastric mucosa are compressed with intestinal clamps, approximated, and stitched together by a continuous serosubmucosal suture as shown in Figure 3, B. Each organ is then opened for a distance of 2 centimeters, as indicated by the dotted lines in the same figure. The anastomosis is completed by following the usual procedure.

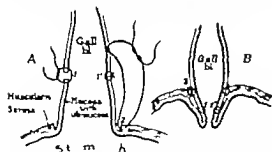


Fig. 5. A, Diagram of section taken in plane represented by the arrow in Figure 4, taken in the longitudinal axis of the anastomosis. An untied interrupted suture connects all layers of the gall bladder, all of the gastric mucosa and adherent submucosa. Interrupted suture not tied. B, Illustrates its passage from point in the all of the gall bladder to 3 centimeters above its fundus and through point in the seromuscular layer at the edge of the gastric incision. C, Illustrates sutures —1' and —1' tensioned and tied, and hence the completion of the invagination with its resultant shelf-like formation.

Four to 6 sutures are now placed anteriorly in exactly the same manner as those placed posteriorly, as illustrated in Figure 4, A. First the posterior interrupted sutures are tensed and tied and then the anterior ones (Fig 4, B), causing the entire process of gastric mucosa and gall-bladder fundus to invaginate into the lumen of the stomach, as depicted diagrammatically in Figure 5.

To close the remaining ends of the incision originally made to produce the maximum of mucosal herniation, interrupted sutures are employed, as shown in Figure 4, B. The same figure also illustrates two corner sutures which have the purpose of further inverting and narrowing the lumen of the anastomosis, and thereby puckering the circular fold of the valve for greater efficiency. A piece of omental tissue may be applied externally to the anastomotic junction as an additional precaution against biliary leakage.

Diagrams A and B of Figure 5 represent sections taken through the longitudinal axis of the anastomosis, that is, in the direction of the arrows in Figure 4, and illustrate the mode of production of the valve. Points *x* and *x'* in A indicate respectively the two steps in placing the sutures and joining the opened gall bladder and gastric mucosal diverticulum. Suture 2, placed but not yet tensed in the same diagram, shows its course from a point in the wall of the bladder, about 2 to 2.5 centimeters above the anastomotic junction, to and through the seromuscular layers at the edge of the incision in the stomach. Diagram B of Figure 5 depicts the invagination com-

pleted by the tensing and tying of all sutures 2, with the resultant formation of the circular valve.

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# THE SURGICAL TREATMENT OF UNEQUAL LEG LENGTH

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**I**NEQUALITY of leg length is a frequent cause of unsightly gait which must always be remembered in analyzing disability in the lower extremities. Frequently the causative agent or disease has long since disappeared or has been brought under control, the inequality in leg length remaining as the important residual disability. In previous decades the orthopedic surgeon was content to prescribe a raised shoe or other appliances, but in recent years the comparative safety of aseptic bone surgery and the development of good technical methods of shortening or of elongating the long bones have caused such palliative measures to become antiquated except when indicated for minor discrepancies of leg length. Most leg length discrepancies of 1 to 4 or 5 inches can be eliminated by an appropriate surgical procedure. Such methods should be applied as early as possible in life to avoid personality maladjustments and are rarely indicated after the twenty-fifth year. A review of the causes of unequal leg length is presented in Table I. Infections, polyomyelitis, and trauma are most commonly encountered.

## PREVENTION OF SHORTENING

Correct treatment of the conditions mentioned inaugurated at the earliest possible date will do much to reduce the incidence of inequality of leg length. Early attention to tuberculosis and to pyogenic osteomyelitis will avoid perforation of the infectious process through the epiphyseal cartilage and into joints, two of the major mechanisms producing unequal limb length in these conditions. Surgical treatment of tuberculous joints at the appropriate time is to be preferred to the purely conservative management of these infections, as in many instances atrophy is promoted and longitudinal growth retarded by prolonged immobilization in a cast. Unequal involvement of the epiphyseal growth cartilage with resultant deformity as well as shortening by enchondromas, gummas, or infections can be combated by repeated observation and appropriate operative closure of the growing side of the epiphyseal line. Unequal limbs, the sequelae of poly-

myelitis, are rare in cases from the more recent epidemics as prolonged immobilization has not been prescribed often, and patients are now encouraged to walk suitably braced within a few weeks or months after the onset of the disease. The early recognition and treatment of tumors and fibrocystic and suppurative bone disease will avoid pathological fracture which is at times complicated by shortening.

## PHYSIOLOGY OF BONE BEARING UPON LONGITUDINAL GROWTH DISTURBANCE

Closure of epiphyseal lines by trauma associated with fractures has been reported by Compere (14) and others. In fractures of the shaft of the femur in young children with shortening the result of overriding there may be equalization of limb length by compensatory overgrowth at the metaphyses of the bones of the shortened leg, as shown by David. However, the older the child, the less the amount of compensation. A difference of leg length up to 1 inch or slightly more may be concealed by tilting the pelvis.

Involvement of the epiphyses about the knee is likely to contribute more shortening than that at the hip or about the ankle, since the studies of Digby, Blagard (8) and others (46) indicate that approximately 13, 40, 38, and 30 per cent of the growth of long bones in the lower extremity occurs at the upper femoral, lower femoral, upper tibial and lower tibial epiphyses respectively. From a practical point of view operative fusion of the hip in very young children when the epiphyseal line is of necessity damaged or bridged by bone grafts, results in very little or no shortening unless there is prolonged cast immobilization (46). The same thesis has been experimentally demonstrated by Compere and Garrison (16) and by Harmon and Adams in children in whom the capital femoral epiphysis has been destroyed by suppuration. In the latter case it is not certain if the mechanism operating is that of overgrowth at the epiphyses on the diseased side, the side operated upon, or compensatory slowing of growth in the epiphyses of the sound limb.

Elongation of bone produced by abnormal asymmetry or by disease in the region of the metaphysis is occasionally observed, but this is not as common as is shortening due to disease. Horton

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Read in part to the Section on Surgery before the Illinois State Medical Society, Peoria, May 9, 1937.

TABLE I — THE CAUSES OF INEQUALITY OF LEG LENGTH

- 1 Fractures
  - a with overriding
  - b into the epiphyseal line creating growth arrest
- 2 Bone infections
  - a pyogenic osteomyelitis
  - b tuberculosis
  - c variola
  - d syphilis
- 3 Bone tumors
  - a enchondromas
  - b exostoses
  - c fibrocystic disease
  - d neurofibromatosis
- 4 Congenital abnormalities
  - a congenital absence or malformation of bones
  - b arteriovenous aneurisms
  - c hypertrophy, regional or hemihypertrophy
- 5 Disuse retardation of growth
  - a residual of poliomyelitis
  - b prolonged cast immobilization in growing children

Conditions 1 and 2 produce shortening by loss of bone or by premature closure of the epiphyseal line

and others have reported cases in children in which arteriovenous aneurisms caused lengthening of bones on the diseased side. Pyogenic foci in the metaphyses, especially if untreated, may stimulate a bone to grow excessively. Most of such overgrowth is either of relatively small extent or is compensated by growth in later years. For a long time it was believed that unilateral lumbar sympathetic ganglionectomy or ramisection would cause stimulation in growth of the homolateral limb as when atrophied from the after-effects of poliomyelitis. However, it has now been shown experimentally by Bisgard (7) and by careful teleroentgenographic measurements in growing boys by Fahey that such operations have no consistent effect on the longitudinal growth of an extremity. This question needs restudy under carefully controlled conditions which will utilize more careful measurements.

#### OPERATIVE SLOWING OF GROWTH OF THE LEG

Phemister was the first to advise that operative arrestment of longitudinal growth be applied to the bones of the longer extremity and described the operative technique that would result in cancellation of epiphyseal growth. This procedure as originally described involves sliding small bone grafts cut from the shaft contiguous to the epiphyseal line across the structure and gouging out the cartilage disc to a depth of 1 to 2 centimeters along the sides (Fig. 1). Thorough and equal disruption of the line of enchondral ossification in the juxta-epiphyseal zone is necessary, since in two of the cases in this series there was evidence

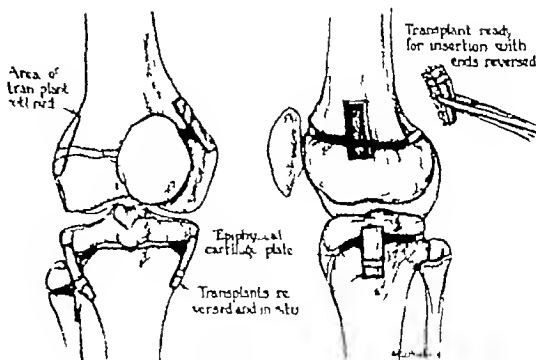


Fig. 1 Technique of epiphyseal growth arrest operation — Epiphysodesis as described by Phemister (Courtesy of Dr. D. B. Phemister and the *Journal of Bone and Joint Surgery*.)

of unequal cancellation of growth on the two sides with deformity. Campbell also reported a case of genu recurvatum caused by unequal operative blockage of the anterior portion of the epiphyseal line of the tibia. This method is applicable for equalization of leg length only during the latter half of the growing period. *It has a definite field of usefulness, but the greatest care must be practiced in the selection of cases for the operation, especially in the selection of the appropriate age for a given amount of shortening.* There is no mathematical formula for obtaining an exact amount of leg equalization by this method. Even when operation is performed under proper indications, the results are occasionally uncertain. Other factors such as the number of epiphyses to be closed and the age at which the operation is to be done should be carefully evaluated. The data given by Hatcher are of extreme value in calculating the probable shortening to be obtained at various ages, since his measurements were obtained by teleroentgenograms. The variability of arrest of longitudinal growth is well illustrated by his material. The usual mistake in this series was

TABLE II — AVERAGE NORMAL GROWTH TO BE EXPECTED FROM LOWER EXTREMITY  
(Calculated from data of Baldwin)

Age in years	Male cm	Female cm
7	28.88	21.05
8	26.47	18.39
9	23.26	16.02
10	20.14	12.16
11	17.07	8.37
12	14.34	6.40
13	10.70	3.51
14	7.27	1.80
15	4.24	0.52
16	2.09	0.14

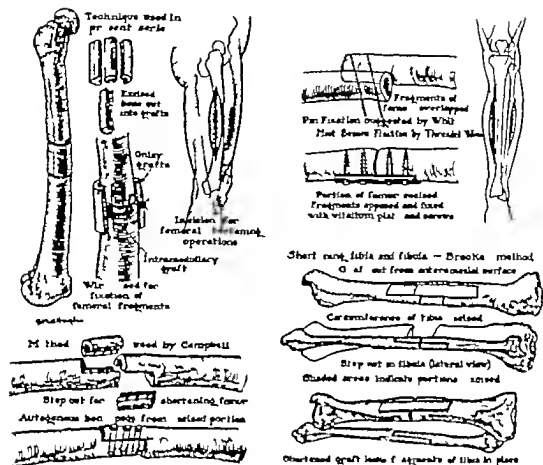


Fig. 1. Methods of shortening the bones of the longer sound extremity. The method of resection, with the use of

failure to operate at sufficiently early age and to arrest enough epiphyses. Data should be available upon racial and familial growth expectancy, the total leg length of the patient and the length of each bone. Cognizance should be taken of sex, since longitudinal growth ceases from 3 to 4 years earlier in girls than in boys (6, 23, 28). This information can be obtained in the usual way by external mensuration, but can be obtained more accurately by stereoteleorontgenograms of the extremities. The approximations based upon the work of Baldwin are given in Table II. The most accurate measurements of growth increments for each bone at various ages in children are available in the article by Hatcher. For 3 inches shortening at the age of 8 in girls and 1 in boys it is generally necessary to treat more than one epiphysis, usually the two at the knee since they together

intramedullary and only grafts employed in the majority of cases of this series.

contribute more than 70 per cent of the total limb growth. Prior to these ages for this or greater shortening it is advisable to arrest only the lower femoral epiphysis or a tibial and fibular epiphysis at one end. The patient should be observed carefully and other epiphyses closed as soon as it is determined that the original closure is of being effective in equalizing the limbs. These general indications should be modified in light of the accessory data for age, sex, and leg discrepancy given in Table II. For example, members of the southern European races in whom short stature is the rule should be operated upon at a relatively early date. Past the age of 1 or 1 in girls and 3 to 5 in boys, this operation should rarely be done as very little or no longitudinal growth can then be expected in the long bones. Roentgenograms of the ends of the bones should always be ob-

tained prior to operation after the age of 9 in girls and 12 in boys to be certain that premature closure of the epiphyseal line has not occurred. In over three thousand miscellaneous orthopedic cases under the age of 21 years, seen by one of the authors during the past 2 years, the growth arrest operation was recommended only eight times. In 43 cases of predominately unilateral acute polyomyelitis, followed for the past 5 years by us, none has developed enough shortening to warrant a limb equalization of any kind. Of these cases, 27 patients passed through the pre-adolescent growth period during this time.

#### EQUALIZATION OF LEG LENGTH BY SHORTENING THE LONG LEG

Shortening of the longer sound limb by excision of a portion of the diaphysis has been reported repeatedly in the surgical literature but has not become popular until the past few years. Rizzoli in 1847 is credited by Steindler as having performed the first leg shortening by cutting the bone and allowing the femoral fragments to override. Sayre was credited with priority (1863) by Brooke who used the same method. Cases have been reported by Mayer and Nussbaum, Glessner, Taylor, Fassett, Calvé and Galland, Shands, and others (11, 18, 30, 31, 34, 37, 38). White (45) and Brooke presented bibliographies, while Calvé and Galland and Brooke brought out and described methods that were sound, the latter being the first to describe an operative method of shortening the tibia.

These methods are all more simple than the methods of operative lengthening. In addition, the likelihood of disaster is slight in the shortening operation, while unfavorable complications are common during the lengthening procedure. This method of leg length equalization has an extensive field of application, since it is mathematically accurate when the more exact methods are employed. The risk is greater than in the epiphyseal arrest operation but not sufficiently so to prevent wide application. Either the tibia or femur may be shortened as much as three inches, but the femoral shortening operation is usually more applicable. The site of election for shortening is at the junction of the middle and lower thirds of the femur and in the middle third of the femur. Only the mathematically exact methods are described here, since shortening by allowing the osteotomy fragments to override is inexact and difficult to control.

The technique employed in shortening the femoral diaphysis in this series of cases is shown in Figure 2. The midshaft of the femur is approached

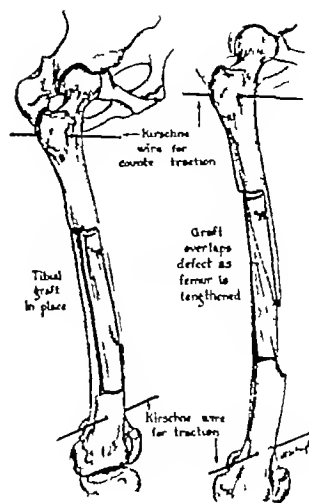


Fig 3 The technique of femoral bone lengthening by means of an autogenous tibial bone graft and skeletal traction (Courtesy of Dr E L Comper and the *Journal of Bone and Joint Surgery*)

along the posterolateral intermuscular septum. The periosteum is incised and stripped only for the length of the proposed shortening. A Gigli saw is then used to sever the bone transversely at the upper limits of the proposed shortening which, in the femur, is usually at the junction of the middle and lower thirds. The distal fragment is angulated allowing its proximal end to protrude from the wound. The desired length of excess bone is removed by a hand saw. The excised bone is then split into several fragments, one of which should be of sufficient size to serve as a snugly fitting intramedullary graft. It should increase in diameter from above downward according to the width of the medullary canal. The remaining pieces of bone are used as onlay grafts to bridge the osteotomy site. Bronze-aluminum wire, which has been used in 7 cases in this series, as illustrated, aids in preventing separation of the bone ends. It is, however, not essential. An alternative technique, advocated by Campbell, is shown in the insert, and the method of tibial shortening described by Brooke is also shown. His accurate step cut operation on the fibula is not essential. Such modifications are technically more difficult and require wider periosteal stripping. They have the merit of preventing angulation by internal fixation. The same effect has been obtained by attaching an onlay graft to the lateral cortex with either autogenous bone pegs or with screws. Vitallium plates and screws have come into favor during recent years. Whether used for fixation or not, the

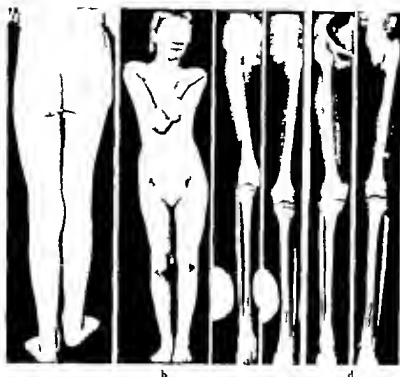


Fig. 4. Case V. II. Illustration of leg equalization obtained by epiphyseal growth arrest on the distal (left) femur and subtrochanteric osteotomy at the right hip. a, Appearance prior to operation. The right hip is solidly ankylosed due to congenital tuberculousis; this leg to clinical measurement is 4 inches (10 cm.) shorter than the left. Teleroentgenographic measurements show the right leg to be 3 centimeters shorter than the left. b, Anterior view of the same patient, 4 years later. Note that the left knee is slightly higher than the right, but that there is equalization of leg length and good stance. This result is achieved largely by subtrochanteric osteotomy and abduction of the distal right fragment. c, Teleroentgenograms of both lower extremities taken at the time of the growth equalization procedure. Note that the tibias are of equal length and that the shortening is to some extent due to superior displacement and malposition (adduction) of the left femur. d, Teleroentgenograms of the lower extremities 7 years after growth arrest operation. Note correction of the deformity of the right hip by osteotomy and that the left tibia is now longer than the right. However in standing position, the level of the ankle joints is approximately the same. Measurement of the teleroentgenograms showed that the patient had actually gained but 6 centimeters on the right side.

autogenous bone grafts derived from the excised segment should be added as onlay grafts.

#### OPERATIVE LENGTHENING OF THE BONES OF THE LOWER EXTREMITY

These operations should be considered only in light of the indications presented by each patient and with full knowledge of the risks involved in operation as the experiences recorded during the past 15 years have demonstrated the many complications that can arise after these operations have been performed. The detailed technique of operation and the types of apparatus to be used

for this purpose will not be described here as they can be found in the original descriptions by Putti, Abbott (1), Abbott and Crego (2), Moore, Habash and Finkelstein, Compere (4), Alcorn, West and others (5, 3, 29, 45). The procedures described previously which are more simple are recommended, but there are cases in which the patient, usually already short, is reluctant to sacrifice standing height. The indications for this operation are the following: (1) Leg length discrepancy should be such that it will be totally or almost totally corrected by operative lengthening (between 1 and 3 inches per bone). (2) Adequate

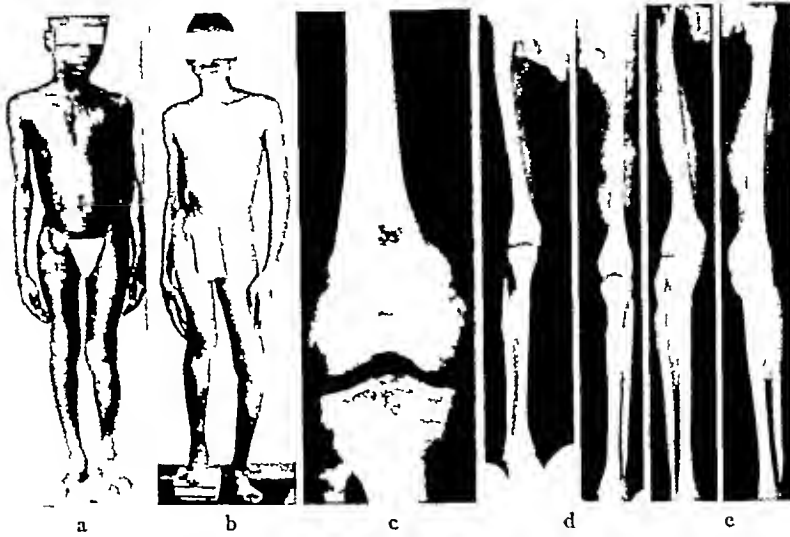


Fig 5 Another case, J P, illustrating leg equalization by tibial, femoral, and fibular epiphyseal arrests upon the left leg, but failure to obtain a good functional result due to contractures and malposition at the hips a, Appearance prior to operation about the left knee. The right leg to clinical measurement is 3 inches (7.5 cm) shorter than the left. Teleroentgenographic measurements show the femur and tibia on the right to be a total of 4.4 centimeters shorter b, The same patient 2½ years later. Leg length has been almost equalized at this time, but clinical measurements show a greater discrepancy in functional leg length, due largely to adduction at the right hip, abduction at the left hip, with corresponding pelvic tilt c, Knee joint roentgenogram—showing appearance immediately after operation d, Teleroentgenographic prints of the lower extremities prior to operation. Note that the shortening is both in the femur and in the tibia. The right leg is 4.4 centimeters shorter by measurements from the tip of the trochanter to the distal tibial articular cortex. Note also loss of substance of the head and neck of the femur and the adduction deformity at the right hip e, Teleroentgenograms of the lower extremities taken 3 years after the growth arrest operations. Note elongation in all the bones of the legs. The femurs are of practically equal length as measured from the superior acetabular articulation to the intercondylar notch. The left tibia is now longer than the right. Measurement of the teleroentgenograms show the right leg to be 1.0 centimeter longer, a total gain of 5.4 centimeters, due to the growth arrest operations. This growth occurred in the age span from 13 to 16 years.

musculature should be present about the hip, thigh and calf (3). Bone must be suitable for the lengthening operation. It should not be done when osteomyelitis has caused the shortening or when the bone is markedly atrophic from any cause.

The operative principles which should be employed are the following: there must be complete control of both fragments by pins inserted through the bone which are mounted in a suitable apparatus to regulate angulation and the rate and extent of lengthening. When the operation is performed, stripping of the periosteum should be limited to the bony area involved in the osteotomy and the length of the osteotomy should not greatly exceed the desired lengthening. An oblique or preferably a Z-osteotomy may be performed. In case of the leg, certain soft tissue structures and the fibula

should be incised to avoid angulation and other complications. The modification described by Compere (15), consisting of the addition of a large tibial bone graft to the osteotomy site, is an advantage, as this extra bone shortens the period of disability and lowers the incidence of malunion and nonunion. It is illustrated in Figure 3, which shows a femoral lengthening before and after extension. Abbott and Bost (3) recently modified the tibial lengthening technique in light of cadaver experimentation, so that the tendency to angulation of fragments is lessened and a satisfactory outcome is more likely.

#### RESULTS INCLUDING ILLUSTRATIVE CASES

*Epiphyseodesis.* This operation has been applied to over 120 patients at the University of Chicago Clinics, many having had more than one



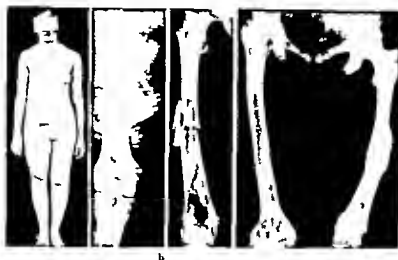


Fig 6. Case A. C. Illustrating operative shortening of the longer femur. a, Appearance of patient 4 years following shortening of the right femur. b, Anteroposterior roentgenograms of the shortened right femur in the cast immediately after operation and on the occasion of cast change. Composite roentgenograms of the femurs 4 years after the femoral shortening.

epiphyseal line closed. There have been no post operative infections or deaths. The short leg has overgrown the sound leg upon which the operation was performed in 2 patients, one by a half inch and the other by an inch. There was no resultant limp or other disability in these 2 cases, as they were able to compensate by tilting the pelvis. In several cases especially in girls, the desired retardation of the sound leg was not obtained as

the operation was performed too late. The general tendency has been to operate too late rather than too early in the growth period and to arrest growth at the knee only in the femur when now the tibial and fibular epiphyses would also be attacked.

VII (Fig 4). 20 years of age at the time, February 6, 1932, of closure of the lower femoral epiphysis of the sound left tibia, which was 4 inches (10 cm) longer than



Fig 7. Case R. B. Illustrating femoral and tibial lengthening. a, Appearance of patient prior to operation. b, Patient 1 year later after lengthening of tibia and femur. c, Lateral roentgenograms of osteotomized femur. The leg is supported upon Braun frame. Note pins through distal

and proximal fragments. d, Roentgenogram of femur after consolidation of fragments. e, Anteroposterior and lateral roentgenograms of osteotomized tibia and fibula. Note the double sets of pins. f, Anteroposterior and lateral view of tibia and fibula after consolidation of fragments.

al measurement. The actual discrepancy in the bones was but 3.0 centimeters. This shortening was due to tuberculosis in the contralateral hip, which was firmly ankylosed in some adduction at the time of the operation for growth equalization. The legs were found equal in length on examination January 1, 1935, the patient having been able to discard her built up shoe 8 months previously. In the interval a subtrochanteric osteotomy had also been performed to correct the adduction deformity. When last seen, April, 1939, her gait was excellent, the tuberculosis process still quiescent, and she was well satisfied with the results of all the corrective operations. Teleroentgenograms of this patient before and 7 years after operation are shown in Figure 4. The result in another patient is shown in Figure 5.

*Diaphyseal resection for shortening the longer extremity.* At the time of this report, we have observed 25 patients who have had operative shortening of the femur of the sound extremity, all having more than 2 inches discrepancy due to previous disease or atrophy in the opposite leg. The results have been excellent save in one case in which infection followed with loss of bone grafts and with persistence of slight angulation of the femur. Union, however, occurred in all cases. Some angulation of the upper fragment occurred in 3 other cases, but this was corrected by change of cast before bony consolidation was complete.

A. C., female (Fig. 6), who was 20 years at the time, August, 1936, of excision of 2 inches of bone from the right femoral diaphysis, presented an inequality of leg length of 2 3/4 inches due to tuberculosis of the opposite hip and knee. The hip had been firmly ankylosed for years, but an injury to the left leg had occasioned an exacerbation of symptoms in the quiescent knee that had been held by a fibrous ankylosis. Resection of this knee was performed in May, 1935, with prompt osseous union. The additional shortening occasioned by the latter operation had led to the development of equinus in the foot of the short limb, and the foot became painful due to excessive strain. Figure 6 shows the appearance of the site of operation immediately following excision of bone from the diaphysis. Union promptly occurred. The appearance of the osteotomy site, almost 3 years later, is shown in Figure 6c. Her gait was improved as a result of the shortening operation, and pain has been absent in the left foot, as the equinus position is no longer necessary in walking.

*Leg lengthening operations.* Eleven operations have been performed, 4 on the tibia and 7 on the femur, on 10 different patients. Death from cellulitis and septicemia occurred in 1 patient who had moderate amyloid disease that was undetectable by the Congo red test. Moderate infection, followed by massive sequestration of portions of the femoral diaphysis occurred in 2 other patients. In 1 of the latter, a stiff knee also resulted. Most of these cases have previously been reported by Compere (15) and will not be presented individually here. In one instance, tibial lengthening was performed upon the leg that had undergone operative lengthening of the femur.

R. B., male (Fig. 7), case of Dr. E. L. Compere, was 17 years of age when first seen. At this time the left leg was 6 inches (14.5 cm) shorter than the right, as a result of atrophy incident to 3 years' immobilization of the left hip by a cast for the treatment of tuberculosis. The cast treatment had not resulted in bony ankylosis, but there had been no pain or other symptoms for 6 years, and there remained 15 degrees of passive motion at the left hip. The tuberculosis was considered quiescent. Both the femur and tibia were lengthened, 8 1/2 months elapsing between operations. The femoral lengthening of 2 3/4 inches was obtained over a period of 3 weeks. Union was present 2 1/2 months after operation. Two and a half inches increase in length of the left tibia was then obtained through the use of the Moore modification of the Abbott apparatus. The patient was last seen 5 years after the first operation was performed. At this last date he had only 0.5 inch discrepancy in his leg length, as determined by clinical mensuration, and he walked with only a slight limp that was due mainly to the abnormality at the left hip.

#### SUMMARY AND CONCLUSIONS

1 Cases illustrative of three surgical methods that are used to equalize leg length are presented.

2 The indications and special conditions appropriate for each are enumerated.

3 Epiphyseodesis or epiphyseal arrest is the most conservative surgical method. It has a definite field of usefulness, which is limited to the seventh to the twelfth years (fifteen in boys only), depending on the amount of shortening.

4 More study of growth rates under normal and especially pathological conditions is indicated. Under certain conditions compensatory growth probably occurs and the importance of the capital femoral epiphysis is minimal. When growth is more fully understood and cases can thus be better selected for epiphyseodesis, better results will be obtained. There is some uncertainty as to the degree of equalization that will be obtained, and undercorrection instead of overcorrection has been the most frequent undesirable result. Undercorrection can probably be eliminated by more careful selection of patients and earlier operation.

5 The most exact and universally applicable method is operative shortening of the sound extremity. Leg shortening is the most exact and frequently indicated operation in adults and adolescents. The extent of its usefulness and restrictions in younger children has not yet been satisfactorily determined.

6 Leg lengthening is indicated in certain patients who are short of stature but should be performed only by a limited group of surgeons who are experienced in the field.

The authors are indebted to Dr. Dallas B. Pbenister for many helpful suggestions in the preparation of the manuscript and his aid in evaluating the material presented. We are indebted also to Dr. C. H. Hatcher for the teleroentgenograms and teleroentgenographic measurements which he made for us.

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# DIVERTICULA OF THE URINARY BLADDER

## A Clinical Study of 236 Cases

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**A**LTHOUGH the medical literature for the last two centuries contains descriptions of diverticula of the urinary bladder, it is only recently, as a result of the routine use of the cystoscope and of cystography, that their clinical significance has been appreciated.

The term vesical diverticulum has come to be reserved for a pouch unrelated to any obvious error of development in the bladder wall, the cavity of which is continuous with that of the bladder through a more or less narrowed orifice. Formerly, the term was used to include definite developmental anomalies, such as a patent urachus, accessory ureters, ending blindly, and the hour-glass bladder, now, however, these conditions are no longer classified or designated as diverticula.

Most of the cases described by the older writers as diverticula were discovered at autopsy, in rare instances, however, diagnosis was made by palpation or at operation. Frequently, diverticula were recorded as accessory bladders. Double bladders and even triple bladders have been described.

### HISTORICAL

Before presenting the results of this study, which is based on 236 cases, it might be well to review briefly the historical side of the subject.

Diverticula of the bladder were recognized by Albucasis in the eleventh century, Guy de Chauliac in the fourteenth century (quoted by Neult), Blasius in 1677 and Morgagni in 1769 also report diverticula. Other early writers were Brusière, Lambratti, Fannoni and Malgett.

According to Fisher and Pugh, Morgagni (1682-1771) was the first to place diverticula on an anatomicopathological basis. On the other hand, Herbst accredits this achievement to Lorenz Heister (1683-1758). Heister, who was often quoted by Morgagni, denoted all protrusions of the bladder as diverticula and probably originated the term (quoted by Polkey). Morgagni wrote extensively on bladder saccules and cited the following physicians as having discussed sacculi: Ranlin, Riolan, Collot, Heister, Ruysch, Bergert.

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and Dodnaens. Honsted (1743) advanced the idea of urinary retention and hernia of the bladder mucosa. Polkey made a very complete and detailed review of the history of diverticula, to which those who are interested may refer.

The early writers used such terms as double bladder, bladder cells, bladder cysts, saccules, sacs, pouches, false bladder, etc., interchangeably with the term diverticulum, as describing any cavity connected with the bladder by an orifice. In the literature we find "double bladders" described by Rauling, Riolan, Blasius, and Collot, which were undoubtedly diverticula. Fischer states that as late as 1863 Michele Scibelli describes a case of congenital double bladder with a much dilated lower end of the right ureter as a "triple bladder."

The first case of vesical diverticulum successfully operated was that of Czerny in 1896. In 1906 Young found 5 reported cases in which the diverticulum had been successfully excised and added 3 of his own. Six years later Leche reported a successful radical removal of a diverticulum and found 14 cases in the literature.

### ETIOLOGY

In a discussion of the etiology of diverticula of the bladder it might be well at the outset to call attention to several well recognized clinical facts: (1) diverticula always or nearly always are associated with obstruction at or in front of the bladder neck, (2) they occur with greatest frequency during the period when prostatic obstruction is common, (3) the rare cases seen in children always have some type of bladder neck or urethral obstruction, (4) the lesion is rare in women since bladder neck obstruction is also rare in women, (5) they are always associated with a thickened bladder wall.

These facts justify the assumption of some sort of relationship between bladder neck obstruction, with its increased frequency of urination, difficulty and straining to overcome the obstruction, with increase in the intravesical pressure and thickening of the wall of the bladder, and the presence of the diverticulum.

Since the earliest knowledge of vesical diverticula the question of their etiology has been a

subject of debate. According to Morgagni quoted by Fischer hypertrophic changes of the bladder wall caused by hypertrophy of the prostate were the cause of their production. Cruveilhier was responsible for the theory that the pouch was a hernia of the mucosa through the muscular coat. He termed the condition *hernia tunicae* on the ground that he considered its distinguishing feature to be the lack of a muscular coat. Later when this author and others including Virchow, Robello and Birch Hirschfeld found that some diverticula contained muscle fibers, they advocated the theory that diverticula were of two kinds: those of congenital origin having muscular elements, and those of acquired origin without these elements. But today this classification has been practically discarded.

Besides these theories we have writers who strongly advocate the congenital origin of all diverticula and others who believe that they are all acquired.

Rokitansky was of the opinion that diverticula are found only in bladders having hypertrophied walls and that the mucosa is forced between the muscle bundles, the opening being at first slit like and then rounded. This forcing out of the mucosa according to Rokitansky is due to the fact that interstitial changes in the muscle bundles cause uneven resistance which invites sacculation.

Whether or not there is a congenital factor that plays a rôle in the development of a diverticulum is a point that is still under debate. Many authors make the positive statement that in their opinion there is no congenital factor responsible for the production of the diverticulum. On the other hand, some authors have taken a very definite stand on this question and are of the opinion that a congenital factor plays an important rôle. Dav and Martin believe that there are two factors present, namely embryological defects constituting weak spots in the bladder wall and superimposed obstruction. Pugh concludes that there are congenital spots in the bladder wall in all cases, and Harris advances the theory that probably they are developmental defects in the muscular wall. Judd and Scholl state that diverticula are probably due to an embryological defect weakening the musculature usually at the base or the result of a defect hiatus in wall of the bladder.

Rose believes that all diverticula are undoubtedly congenital because an unprotected direct loose fibrous connective tissue pathway must exist through the bladder wall before herniation results.

Herrmann attributes diverticula to the inherent weakness in the bladder wall at some point, thus

making sacculation prone to occur with increased intravesical pressure.

Lower states that it is not improbable that there is a congenital predisposition to diverticula, and that their development and clinical recognition during adult life are hastened since their dimensions are greatly increased by any of the factors which would bring about increased vesical distention or increased activity of the bladder musculature.

Hinman states that the vesical diverticulum is the result of three factors, namely the anatomical, the pathological, and the mechanical conditions.

And finally I would call attention to the extremely interesting observations regarding the etiology made by Watson 8 years ago. As a result of his studies of the vesical cavity in its progressive development from early fetal life until birth he came to the following conclusion:

"The variation and inequality of the intrapelvic and lower abdominal pressure has been noted in a considerable number of fetuses studied. This has caused the bladder at times to become somewhat distorted and the inner folds of the bladder to become extremely irregular. High ridge-like elevations standing out prominently in several areas of the cavity, but more particularly in the zone about the lateral angles of the trigone. These irregularities, augmented by the general processes of growth, may project into the vesical cavity as dentate finger-like excursions, or the projections may remain as simple levated ridges which never develop sufficiently to bridge the corners of the bladder. If the intrapelvic pressure becomes of real significance early in fetal life, the probability of bridging of the corral cavity is much more imminent than when it develops during the later months of intra-uterine life. Varying degrees of these irregularities have been demonstrated in the specimens studied, from simple ridge-like elevation to those which traverse the entire vesical cavity and touch the mucosa of the opposite bladder wall. In certain instances, when the pressure is more lateral they may form bridges along the same side of the bladder from which they originate. When these finger-like projections traverse the bladder cavity and touch the mucosa of the opposite side, certain regressive changes occur in the approximating mucosa, indicated in the poor staining qualities of the epithelium and later by disintegration of the lining cells which allow the mucosa and portions of the muscularis of the portions of the bladder wall to lie in apposition.

#### RELATION OF VESICAL DIVERTICULA TO OBSTRUCTION

The presence of obstruction in cases of vesical diverticula and its rôle in their production has been recognized for centuries, although some authors believe that they may develop without obstruction. In view of the fact that modern urological study shows obstruction in practically all cases, it is fair to assume that the cases reported in the older literature as cases without obstruction were probably insufficiently studied,

the obstruction overlooked, or the cases incompletely recorded

A review of this series of 236 cases showed that complete data on the question of the presence of obstruction were at hand in 230 cases in 3 of the early cases the records are incomplete and in 3 cases the diverticula were found associated with extensive carcinomas of the bladder. Therefore, in the 230 cases in which data are at hand, obstruction was found in each instance or in 100 per cent.

TABLE I —TYPE OF OBSTRUCTION

	Cases	Per cent
Benign prostatic hypertrophy	153	66 52
Median bar	34	14 78
Contracted internal urethral orifice	18	7 82
Carcinoma of prostate	17	7 39
Stricture of the urethra	5	2 19
Congenital valves in posterior urethra	3	1 30

## AGE

The largest number of cases of vesical diverticula occurs in the age period after fifty, a time of life when obstruction at the bladder neck is common. It must not be forgotten, however, that diverticula do occur before fifty and that the condition may occur in childhood and even in infancy.

In a previous article published in 1934, I reported 6 cases of diverticulum in children, the youngest of which was 12 days old and the oldest was 2½ years. In 3 of them the diverticulum was due to the presence of congenital valves in the posterior urethra, in 2 it was due to contracted internal urethral orifices, and in 1 case the autopsy records failed to mention anything about a causative factor. Since this article was published I have seen 3 more cases of diverticulum of the bladder in children.

A review of this series showed that 87 per cent occurred after the age of 50 years, and that the largest number occurred in the sixth decade, or in 32.2 per cent, 30.6 per cent in the seventh decade, and 6.2 per cent in the eighth decade.

TABLE II —AGE

	Cases		Cases
12 days to 10 years	0	50 to 60	40
10 to 20	1	60 to 70	76
20 to 30	3	70 to 80	71
30 to 40	4	80 to 90	15
40 to 50	14	Not stated	3

## SEX

Diverticula of the bladder are vastly more common in the male than in the female. This statement has been made a good many times by many authors over long periods of time and I wish to

subscribe to it. In this series of cases there were 7 females and 229 males.

Among the authors who stress the great preponderance of males over females may be mentioned Durnieux, Lurz, Legueu and Papin, Casuto, Hinman, Judd and Scholl, Lower, and many others. Stirling and Rollings found 4 females in a study of 12 cases, an unusual sex proportion.

A brief summary of the 7 cases in females is given in Table III.

Diverticula may be either single or multiple. The incidence in this series was single diverticula, 137 cases, multiple diverticula, 99 cases.

## PHYSIOLOGY

Much interest has always centered around the question of whether or not the diverticulum has the power of contraction and hence the ability to empty. Cabot states that it is not clear whether or not the diverticula in their early stages are capable of emptying themselves and are therefore harmless, or whether they are continually the site of residual urine.

Based on their ability to empty, diverticula have been divided into two groups: those that empty and those that do not. The latter have been called "retention diverticula." Retention of urine in a diverticulum sooner or later predisposes to infection and diverticulitis and often to peridiverticulitis with adhesions to important structures which greatly increases the difficulty in their removal. This phenomenon can be easily demonstrated at the time a cystogram is made by withdrawing the contrast media from the bladder by means of a catheter and taking several roentgen-exposures to see not only if the diverticulum is empty after the bladder has been catheterized, but also to demonstrate by repeated roentgenograms just how long it does take the diverticulum to empty if it belongs to the retention type (Fig. 1).

## SIZE

Diverticula may vary in size within wide limits containing from 15 cubic centimeters to several liters (Fig. 2). In some instances the diverticulum may be several times the size of the bladder, so that the diverticulum is mistaken for the bladder and the large diverticulum is at first diagnosed as the bladder and the bladder as the diverticulum. Although this combination of a very large diverticulum and a normal or small bladder does not occur frequently, it is of great importance to bear this possibility in mind when reading the cystograms. I have seen several instances of this kind (Fig. 2). Cases have been reported in the litera-

TABLE III—DIVERTICULA OF THE BLADDER IN WOMEN

Case	Symptoms	Duration	Location	Sex	Associated lesions	Remedy	Method of diagnosis	Urine	Treatment	Remarks
M. H. N. S.	Frequency Incontinence Nocturia Retention	yr yr 6 mos	Mural to and behind right ureteral orifice		Contracted internal urethral orifice Bilateral pyelonephrosis	47 cm	Cystoscopy	Albemon + Pus +++ Bacillus coli Staphylococcus	No treatment Sect. at consultation	
Mrs. S. A.	Hematuria Frequency Nocturia Pain and difficulty on urination Cystitis Pyuria	mos mos 3 mos no mos days	On the right, left and posterior walls	M	Contracted internal urethral orifice Hypertrophied interurethral ligament	Not stated	Cystoscopy	Albemon + Pus +++ Bacillus coli	Suprapubic cystostomy Wider shaped urethra of bladder neck Resection of hypertrophied interurethral ligament	Complete relief of symptoms
Mrs. M. O.	Albumin in urine Backache No urinary symptoms	Not stated Several years	On the left internal wall near the ureteral orifice		Bur's at each of bladder	5 cm	Cystoscopy	Pus ++ Bacillus coli	X-ray	Discovered diverticulum on cystoscopic examination
Mrs. M. R. et	Frequency Incontinence Nocturia Retention	yr yr yr yr	Left lateral wall above left ureteral orifice		Contracted internal urethral orifice	16.4 cm	Cystoscopy Cystogram	Pus ++ Bacillus coli Staphylococcus aureus	Electrocoagulation of bladder neck	Lost sensation on June 27, 1918 showed no residual urine
Mrs. N. V. H.	Frequency Nocturia Pain and burning on urination Impurement	mos mos yr yr	Left side of bladder		Extensive carcinoma of the bladder No invasion of rectal lumen No pyelitis	Not done	Intro. exam. proctoscope and cystoscopy	Albemon + Blood +++ Pus +++ Staphylococcus	Resection and hyperplasia of bladder tumor	Discovered during post mortem study to determine cause of hematuria
M. L. F.	Hematuria Frequency Nocturia Backache Nocturia	8 mos	On right lateral wall		Papillary carcinoma of bladder	Not done	Cystoscopy Cystogram	Albemon + Blood +++ Pus +++ Gram positive rods	Excision of bladder tumor	Diverticulum discovered during cystoscopic examination because of hematuria
M. L. Mc's	Hematuria Frequency Nocturia Cystitis	yr yr yr yr	Right side of bladder		Extensive carcinoma of bladder Right hydronephrosis No invasion of rectal lumen	Not done	Intro. exam. proctoscope and cystoscopy	Albemon +++ Blood ++ Pus ++ Staphylococcus	Electrocoagulation and hyperplasia of bladder tumor	Discovered during post mortem study to determine cause of hematuria

M. Multiple

ture in which the diverticulum held a gallon (Green quoted by Targett and 5.5 liters in Potherat's case). The small celluloses so frequently seen with prostatic obstruction are not considered in this paper. A large diverticulum may be present for a great many years without any deleterious effect on the upper urinary tract whereas a small diverticulum in intimate relationship with the ureter may produce a marked hydronephrosis (Fig. 3).

#### THE ORIFICE

The orifice is generally round. At times it is not recognized during cystoscopic examination since severe cystitis may be present and the accompany-

ing large flakes of pus may adhere to the wall of the bladder, covering the orifice or extensive intravascular hypertrophy of the prostate and the presence of calculi may obscure the orifice. During cystoscopic examination changes may be noted in the orifice which give the impression that the orifice has contractile power; that is, that the orifice opens and closes. Some difference of opinion exists as to whether this is due to a true sphincter action or not. Read doubts the presence of a true sphincter. He states that the fibrous ring at the juncture of the sac and the bladder is elastic and that its contractions are influenced by the bladder musculature surrounding it, but that the ring itself is devoid of muscular power.

TABLE IV—CARCINOMA IN BLADDER DIVERTICULUM

Name Sex Age	Symptoms			Urine			Culture	Associated pathology	Histology	Treatment	Result
	Hematuria	Pain	Frequency	Nocturia	Albumen	Blood					
F G K M—39 yrs	+	o	o	o	++	+++	Staphylococcus albus	Hydro-ureter left Hydrocephrosis left Median bar	Epidermoid carcinoma	Nephro-uretero diverticulectomy 2 2 39	Cystoscopic examination 10-10-39 negative Severe abdominal pain
K.S. M—64 yrs	+	o	+	o	+	+++	Bacillus coli	Benign prostatic hypertrophy Papillary carcinoma of bladder	Papillary carcinoma	Fulguration of tumor in diverticulum Electroresection of Prostate 11 2 38	Cystoscopic examination 10-24 39 negative
E A B M—63 yrs	+	+	+	+	+	++++	Bacillus coli Staphylococcus aureus	Benign prostatic hypertrophy Papillary carcinoma of bladder	Papillary carcinoma	2 22 32 Suprapubic cystostomy Diathermy of tumor Implantation of 100 mgm. radium in diverticulum Electroresection of prostate	12 18-39 A recent communication states that the patient is getting along very well and enjoys good health to extent of doing a full day's work each day
C.B.* M—51 yrs	+	o	+	+	++	++++		Contracted internal urethral orifice	Papillary carcinoma	Diverticulectomy 300 mgm of radium placed <i>in situ</i> from which diverticulum was removed	

\*Reported in the Journal of Urology Vol 21 p 381 March 1929

On the other hand, some authors have described a sphincteric action. Thus Caulk observed in a female infant of 3 months an opening which at times contracted into a crescentic slit. Deming states that the mouths of diverticula may have a peculiar sphincteric action. Buerger reported a case of diverticulum with a contractile sphincteric orifice demonstrated by repeated cystoscopic examination, and Day and Martin reported a case in which perfect sphincteric action of the orifice was observed.

#### COMPLICATIONS OF VESICAL DIVERTICULA

The common complication of vesical diverticula is infection. Stone and tumor may occur but they are rare. Tuberculosis and leucoplacia within the sac have also been reported, but are very rare.

**1 Infection** When they present themselves for examination many patients show the presence of infection. Whether or not the infection is secondary to the bladder infection or vice versa is difficult to say. Infection once started is difficult to treat, especially if the opening is small and the diverticulum does not empty. A diverticulitis is almost universally followed by a peridiverticulitis, of greater or lesser degree, resulting in dense adhesions to the surrounding structures, such as the ureters, prostate, seminal vesicles, or rectum. In certain cases the infection within the diverticulum has been so severe as to cause rupture.

A case of rupture was reported by Thomas. This diverticulum was also complicated by a carcinoma.

Some authors are of the opinion that the size and location of the orifice is important in subsequent infection or tendency to perforation, and they state that the smaller the orifice and the more dependent in position the sac, the more difficult the drainage becomes, thus making for severity of the inflammatory process. Dense adhesions result and make removal of the sac at times very difficult, this may lead to injuries of the adjacent organs, thus complicating the diverticulectomy.

In my series of 236 cases I have never seen a case in which there was rupture of a diverticulum.

**2 Tumors** In discussing tumors in diverticula it is necessary to distinguish between tumors which arise within the sac and those which invade the sac secondarily. Papers reporting benign tumors in vesical diverticula have been published by Buerger, Fenwick, Negro, and Blanc, Perthese, and Targett. A sarcoma complicating a diverticulum was reported by Targett, a sarcomatous papilloma by Leuenberger, and a hemangioma cavernosum by Blum.

Kretschmer and Barber, in a review of the relevant literature in 1929, were able to find 20 cases of primary carcinoma arising within a diverticulum and added 1 of their own. Since this time a number of such cases have been reported in the



TABLE V—STONE IN BLADDER DIVERTICULA

Name Sex—Age	Fre- quency	Nec- rosis	Dif- fusely	Pain	Hemo- spermia	Duration of symptoms	Ex- posed	No. of diver- ticula	X-ray	Associated lesions	Urine	Remarks
I. B. D. M—47 yrs	+	+		+	+	yrs	no cm	13	Stones in rectal diverticulum	Benign prostatic hypertrophy Right hydro-nephrosis Right hydro- nephrosis Bladder stones	Albumen + Pus + + + + Bacteria coli	Mucous of the stone from the diverticulum into the blad- der and some in the di- verticulum
R. R. M—50 yrs	+	+				mon	no cm	13	Stones in di- verticulum, left	Contracted bladder neck Bilateral hydro- nephrosis Bilateral hydro- nephrosis Left kidney stone Left ureteral stone	Albumen + Pus + + + + Bacteria coli Streptococcus albus Streptococcus viridans	Macroscopic proved by cystoscopy
F. B. C. M—49 yrs	+	+	+	+	+	mon	no cm	14	Stones in diverticulum	Benign prostatic hypertrophy Bladder stones	Albumen + Pus + Red blood cells + Bacteria coli Streptococcus hemolyticus	
F. K. M—47 yrs	+	+	+			yrs	no cm		Stones in diverticu- lum, left	Benign prostatic hypertrophy Unilateral hydronephrosis Protrusion of bladder	Ure Blood Bacteria coli Streptococcus epididymus	
I. M. M— yrs	+	+	+	+	+	mon	no cm	14	Stones in di- verticulum	Benign prostatic hypertrophy Bladder stones	Albumen + + Pus + + + + Starch + Bacteria coli	
J. C. M—50 yrs	+	+		+	+	yrs		14	Stones in di- verticulum	Benign prostatic hypertrophy Cholelithiasis Acute cystitis Chronic cystitis Bladder stones	Albumen + + Blood + Pus + Bacteria Streptococcus Mucous leukocytes	
M. D. M—50 yrs	+	+	+	+		mon	no cm	13	Stones in di- verticulum	Benign prostatic hypertrophy Prostatic calculi Acute prostaticitis Acute pyelitis Unilateral hydronephrosis Bladder stones	Albumen + Pus + Blood + Bacteria pyococcus	
A. R. M— mon			+			mon	no cm		Stones in di- verticulum	Contracted internal urethral orifice	Albumen + Pus + Blood	

Reported previously in Am. J. of Dis. Children, 1934, 1:1-1:17  
J. M. Murphy

literature including those of Gill, Briggs, Rathbun, Hicks, Well, Irwin and Peacock and Corbett.

In of my cases the patient had both a tumor in a diverticulum and a tumor taking its origin on the trigone (Fig. 4)

In this series there were 4 cases in which the diverticulum contained a tumor. They are presented in (Table IV)

3. *The presence of calculi in diverticula* The presence of a shadow within the bony pelvis, but outside the bladder area, should at once arouse our suspicion that the shadow may be due to stone in a diverticulum (Figs. 5, 6, and 7)

It is not at all surprising that stones occur in diverticula, since two conditions that predispose to stone formation are present in many of these cases, namely: retention of urine and the presence of a nucleus for the deposit of urinary salts. (Pus, bacteria and desquamated epithelial cells.)

Numerous cases are reported in which one or more stones were found within the sac. The stone may be of the dumbbell variety partly within the sac and partly within the bladder, the two segments being connected by a narrow neck, which is surrounded by the orifice of the diverticulum. Stones of the dumbbell variety have been reported



Fig 1 Retention of media in diverticulum after bladder has been emptied with catheter

by Davis, Young, Martin, and Crenshaw and Crompton

Migration of stones from within the diverticulum into the bladder cavity and vice versa is rare, and instances in which this phenomenon has been reported are few. This phenomenon occurred in 1 of my cases (Case 1, in Table V). In this series of cases there were 8 in which stones were found in the diverticula. They are presented in summarized Table V.

4 *Tuberculosis* In a few instances tuberculosis occurring in a vesical diverticulum has been reported. As noted by Blum, such cases are due to an extension of the process from a similar infection of the bladder. The latter may be secondary to tuberculosis of the kidney or the genital tract. This condition has been reported by Duvergey, Jeanbrau (quoted by Duvergey), Cornor and Rountree, and Schacht.

Schicht states that tuberculosis is probably the most unusual of all complications of vesical diverticula. His case was revealed at autopsy. The



Fig 2 Showing enormous size of diverticulum which reaches to the fifth lumbar vertebra

bladder, prostate, and right seminal vesicle were involved in the tuberculous process, as well as the diverticula (three in number). A right nephrectomy for tuberculosis had been done a short while previously.

As far as my personal experience is concerned I have never seen a case of tuberculosis in a bladder diverticulum.

5 *Leucoplacia* Leucoplacia has been reported in vesical diverticula. Bugbee reported such a case and stated that a review of the literature revealed 2 other cases of leucoplacia in a diverticulum without involvement of the bladder. Blum, Czerny (cited by Kretschmer in his review of leucoplacia of the bladder) and Stevens also reported a case of leucoplacia in a vesical diverticulum.

In Table VI is given a list of associated lesions found in this series of cases. The incidence of hydronephrosis is not included since many of the patients were seen before the advent of intravenous urography. Likewise the incidence of stones in the upper urinary tract must be incomplete since in the early cases routine roentgen-ray examination was not employed.

#### SYMPTOMS

There is no symptom or group of symptoms by means of which a positive diagnosis of diverticulum can be made. The clinical picture pre-

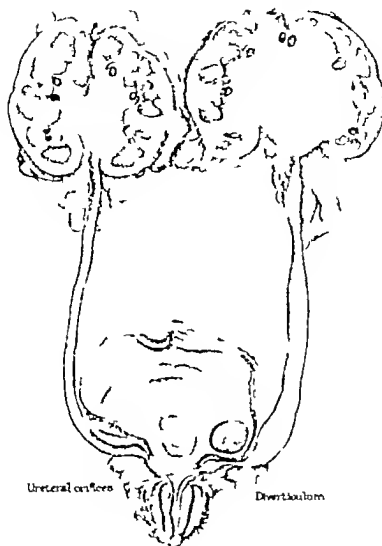


Fig. 3. Autopsy specimen. Note compression of left ureter by the diverticulum.

TABLE VI.—ASSOCIATED LESIONS

	Case
Carcinoma of bladder	14
Bladder stones	3
Stones in diverticulum	9
Kidney and ureter stones	9
Prostatic stones	6
Carcinoma in bladder diverticulum	4
Papilloma bladder	4

sented by the patient with diverticulum is that of bladder neck obstruction. In an occasional case

in which the diverticulum is very large, suprapubic tumor can be felt. The presence of suprapubic swelling, especially to one or the other side of the midline, should arouse suspicion of the presence of diverticulum. Some authors have called attention to the importance of double voiding as a symptom. The presence of suprapubic tumor or its gradual diminution in size after the bladder is emptied with catheter is highly suggestive. Turbid urine or turbid wash water after

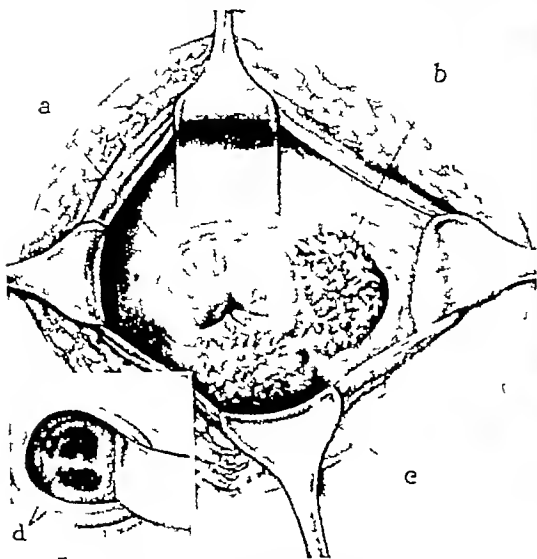


Fig 4 a, Prostate, b, tumor protruding from the diverticulum, c, tumor on the trigone, d, floor of diverticulum after destruction of tumor by fulguration

the bladder has been emptied with a catheter is also suggestive of a diverticulum that is infected and that is emptying its contents into the bladder. Of special significance is the fact that one is obliged to irrigate for a long time before the wash water returns clear.

It might be interesting to call attention to the fact that the number of cases reported before modern diagnostic procedures were used was negligible, and that since the introduction of modern urological diagnosis the number of cases has greatly increased.

The onset is slow and the symptoms progressive. A point of importance to remember is that the bladder neck obstruction is the factor in causing the symptoms to be prolonged. The duration of the symptoms is given in the following table.

TABLE VII —DURATION OF SYMPTOMS

Years	Cases
Under one	47
1 to 5	100
5 to 10	49
10 to 15	22
15 to 20	10
Over 20 years	5
Not stated	3

With but few exceptions the patients presented a history characteristic of bladder neck obstruction to which some cases was added the picture of acute or chronic infection.



Fig 5 Note the large stone in the right diverticulum small stone in diverticulum on left side

Hematuria may be the symptom that brings the patient to the physician. In some cases it may be the only symptom. Under these circumstances our suspicions should at once be aroused for the possibility of a tumor in a diverticulum (Fig 8), a tumor of the bladder, or associated pathology in the kidney.



Fig 6 Stone in bladder Stone in right diverticulum



Fig. 7. Moderate sized diverticulum, left. Note collection of mucus around stone in right diverticulum.

In Table VIII are given the common symptoms and the number of times they were present.

TABLE VIII.—SYMPTOMS

	Cases
Frequency	96
Nocturia	94
Difficulty	14
Lack of force	26
Small stream	3
Hesitation	66
Pain on urination	68
Dribbling	92
Burning	78
Hematuria	76

#### CRISTALYSIS

Because of the presence of obstruction infection is superimposed in the larger number of cases. The association of infection as demonstrated by the presence of pus in the urine was noted in 8—27 per cent of the cases. Pus was present in the urine in 94 cases, no pus was found in the urine in 34 cases, and it was not stated as to whether or not pus was present in 8 cases.

At the present time routine cultures of the urine are made in each case. Unfortunately in many of the early cases this was not done. No attempt will be made to mention the individual organisms found. In some instances only a single organism was noted and in others a mixed infection was present. In 4 cases the cultures were sterile and in 69 cases no mention of the type of organisms is made.



Fig. 8. Not filling defect in lower part of diverticulum due to presence of tumor.

#### DIAGNOSIS

Although the various symptoms and signs arising from this disease may serve to direct attention to its presence, or to suggest its possibility, it is only by means of the cystoscope and cystography that a diagnosis can definitely be made. In the larger number of cases cystoscopic examination makes an accurate method of diagnosis however. I think attention should be called to the fact that the opening of the diverticulum may be overlooked in the presence of a very large prostate, severe infection, bladder calculi, and large bladder tumors.

TABLE IX.—BACTERIOLOGY

	Cases
Bacillus coli	79
Escherichia	
Salmonella	3
Staphylococcus albus	24
Staphylococcus aureus	9
Staphylococcus citreus	
Streptococcus non hemolyticus	3
Streptococcus lactis	
Streptococcus hemolyticus	
Bacillus proteus	
Gram positive rods	
Bacillus pyocyaneus	1
Micrococcus flavus	



Fig 9 Showing filling defect in the cystogram due to large carcinoma of the bladder. Left kidney does not visualize. Right side shows hydro-ureter and hydro-nephrosis. Note diverticulum on right side.

The routine use of cystography will often reveal the presence of one or more diverticula when they are least suspected (Fig 9). In an occasional case, the making of a cystogram is followed by chills and fever, and this is probably due to acute pyelitis. This may be due to a reflux of the media used up the ureter and into the kidney pelvis so that a complete urogram is obtained (Fig 10). The possibility of this phenomenon was emphasized in a previous publication. Of great importance is the fact that not only an antero-posterior film should be made, but a lateral as well, since it is relatively easy to overlook a diverticulum. Contrast cystograms may be made, but I do not use them as routine.

Shadowgraph catheters to outline the size of the diverticulum were formerly used. A catheter in the diverticulum and another one in the



Fig 10 Note reflux of media in both ureters. Large diverticulum on the right side. Smaller diverticulum on the left.

ureter may give information of the relationship between the diverticulum and the ureter. After the catheter has been passed into the diverticulum, it may be outlined by injecting contrast media into it.

In all of our cases of bladder neck obstruction routine urograms were made. As a result of this procedure, diverticula are demonstrated when least suspected. If for any reason a satisfactory outline of the diverticulum is not obtained, a cystogram may be made at a subsequent date. A cystogram is also of value in demonstrating whether a diverticulum has the power of emptying itself, a matter of importance since by this means one can designate between the so called non-retention and retention type of diverticulum. In addition the intravenous urograms show the presence of a unilateral or bilateral hydronephrosis when least suspected.

#### PROGNOSIS

The prognosis is good provided the sac has been completely excised, the bladder neck obstruction removed, and residual infection eradicated. The vesical diverticulum in itself should not offer a bad prognosis. However, the degree of gravity of the outlook is determined by the amount of associated pathology, which is either the direct or the indirect result of the diverticulum.

The prognosis is influenced by such complicating factors as multiplicity of diverticula.

marked degrees of infection, extensive peridiverticulitis, stones in the sac, carcinomatous changes in the sac, the relation of the orifice of the diverticulum to the ureteral orifices, the relation of the sac to the course of the ureters, renal damage, due to ascending infection and obstruction, and the age and physical condition of the patient.

As is well known, diverticula may be present for many years and not cause damage to the urinary tract; however, this is the exception and not the rule. In isolated instances, large diverticula have been found at autopsy which have caused no bladder symptoms and the patient died as a result of entirely different conditions.

It stands to reason that a large diverticulum must add, except in rare instances, to the gravity of the situation. On the other hand, if a fibrous diverticulum is small and lies in close proximity to the ureteral orifice the damage it causes may be great.

The location of the sac is of great importance. A large sac located in the dome or in the lateral walls does less damage to the kidneys, and, except for the presence of severe peridiverticulitis, is easier to resect.

#### TREATMENT

The present status of the treatment of diverticula associated with prostatic obstruction is a matter that should invite discussion. Whereas, in the days of suprapubic and perineal prostatectomy all diverticula were removed, at the present time there is a very definite tendency not to remove them as a routine procedure. As a matter of fact, I no longer perform routine diverticulectomies.

In discussing the treatment of diverticula it is necessary to assume that the obstruction at the bladder neck has been removed completely. It is well known that, if the obstruction has been completely removed, many diverticula tend to decrease in size and produce no subjective symptoms. The question as to whether the diverticulum or diverticula, if more than one is present, should be removed will depend upon several factors and demands individualization. I would like to discuss this subject under the following headings:

1. *Small diverticula*—I do not remove small diverticula if the obstruction is removed completely, the urine clear, and subjective symptoms are absent.

*Large diverticula*—Here again, if the obstruction has been completely removed, if the patient is free of symptoms, the urine clear or

slightly hazy due to bacteria and contains few pus cells, and if the diverticulum is not close to the ureter so as to produce ureteral obstruction I am of the opinion that by administering urinary antiseptics and keeping the patient under close observation is all that is necessary. However, if the ureter is obstructed the pyuria does not clear up and there are recurring attacks of chills and fever accompanied with urinary symptoms or if the diverticulum does not empty then I believe that the patient should have a diverticulectomy.

3. *The very large diverticula*—In the very large diverticula, one must take into consideration the size and number of the diverticula, whether or not they retain urine and hence are a source of infection, the amount of infection in the urine and the relation of the ureter to the diverticulum. As a rule, I remove the large diverticula first and then perform the resection.

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# THE OBLIQUE MUSCLE CUTTING INCISION IN ACUTE APPENDICITIS

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WHILE ordinarily the removal of an interval appendix is a simple enough procedure this is by no means always true of the operation of appendectomy when that hollow muscular viscus is the seat of an acute inflammation. Under these circumstances the satisfactory performance of this operation may tax severely the technical skill of an experienced surgeon let alone that of the occasional operator. In some cases, although the position in which the appendix lies relative to the cecum—always an important consideration in any case of acute appendicitis—has been determined correctly before operation even to find the appendix may not be easy in spite of the use of the anterior longitudinal band of the cecum as a guide and still further difficulties may await the surgeon when he comes to the actual removal of the offending organ. One of the basic factors essential for the proper performance of any abdominal operation is an adequate exposure of the operative field, this helping the surgeon materially to overcome such difficulties as may present themselves and when an acute inflammatory process is present, such as acute appendicitis, it results in a minimal amount of trauma to the bowel with diminished risk of spreading infection. This short communication is concerned with an incision which affords not only an excellent exposure of the cecal and appendicular regions but also often permits of a virtual extraperitoneal removal of the appendix. Its many other inherent advantages will be mentioned in due course.

This incision is by no means new and while perhaps it is not possible to know exactly who used it first, in the writer's mind it will always be associated with the name of the late R. Morison Morrison. At the Royal Victoria Infirmary Newcastle-on-Tyne where that surgeon worked and taught for many years, the incision under consideration is always referred to as the Morrison oblique muscle-cutting incision. Professor Morrison began to draw attention to it in his surgical contributions during the latter years of the last century about the same time that Charles

McBurney first described the muscle-splitting or gridiron incision which bears his name. While the latter incision has rightly attained wide recognition and popularity for it led the revolt against the median incision in common use at that time by providing a more direct line of attack upon the acutely inflamed appendix, the former judging from its lack of mention in the literature appears to be but rarely used and little known. The writer feels that up to the present this incision has not gained the recognition it most certainly deserves for it has never been, to his knowledge, either illustrated or described in detail in any of those surgical journals which by this time have come to enjoy such wide circulation. The present note is an attempt to remedy that omission and was prompted by a recent series of cases of acute appendicitis which afforded the opportunity of repeated demonstration of the excellence of this incision. The artist's drawings with which the text is augmented are based upon photographs taken during operations and upon the writer's personal sketches.

The incision is begun in the right flank about midway between the costal margin above and the crest of the ilium below and is continued toward the midline parallel to Poupart's ligament for an average distance of 4 or 5 inches. Thus most of the incision lies lateral to an imaginary line drawn between the anterior superior iliac spine and the umbilicus, in contrast to the McBurney incision which lies mostly medial to it (Fig. 1). The external oblique, internal oblique and transversus abdominis muscles, the transversalis fascia and peritoneum are now incised in turn in the direction of the skin incision (Figs. 2 and 3). The only source of moderate hemorrhage likely to be encountered, other than the branches of the superficial epigastric vessels, is the unnamed branch of the deep iliac circumflex artery which is given off near the anterior superior iliac spine and ascends between the internal oblique and transverse abdominal muscles. If looked for it can be seen easily and hemorrhage prevented by dividing it between forceps. On completion of the wound and retraction of the edges of the peritoneum by the forceps attached to them for this purpose (Fig. 3) certain important features will be noted

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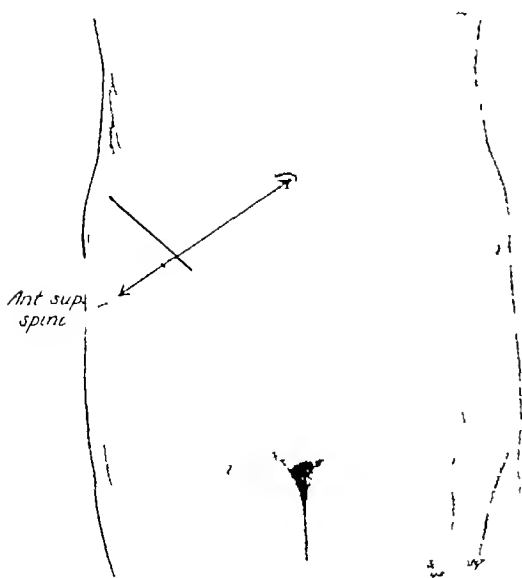


Fig 1 Approximate and relative positions of the muscle-cutting (shown by continuous line) and McBurney muscle splitting incisions

1 A surprising amount of room is provided for surgical manipulations in contrast to that available through the muscle-splitting incision and only occasionally will there be found the need for retractors in the wound. There must be other surgeons who, like the writer, have seen a tense appendix ruptured by the struggle necessary for its delivery through the limited peritoneal aperture which results when the McBurney incision is used.

2 It allows the cecum to be approached from its outer side. Apart from this being of advantage in cases in which the appendix lies in the extra-cecal position, the advisability of working lateral to the cecum as much as possible in every case is not to be denied since it results in a minimum amount of disturbance of the small bowel with decreased risk of the spreading of infection throughout the peritoneal cavity and of postoperative paralytic ileus.

3 The posterior limit of the peritoneal opening will be found to be near the level of the floor of the paracolic gutter where the lower end of this becomes continuous with the floor or posterior wall of the iliac fossa around and behind the cecum. This feature is of the greatest importance when it is considered necessary or advisable to institute drainage of the peritoneal cavity, for the drain will have its exit as near as possible to the position of maximum dependency for lateral drainage.

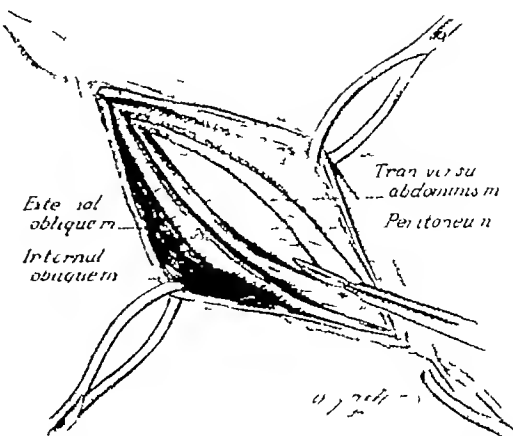


Fig 2 The incision down to the peritoneum. The external oblique has been incised parallel to its muscular fibers while those of the internal oblique and transversus abdominis muscles have been cut almost at right angles to their course. Note the attachment of the external oblique to the wound towels by catch forceps, gentle traction on these forceps gives good exposure of the deeper portions of the wound.

of this cavity. There is thus obviated the necessity of making a separate stab-wound in the flank as when a more medial incision, such as the McBurney and especially the paramedian, is used, for to obtain efficient drainage of the peritoneal cavity through either of these incisions is an anatomical impossibility. Nor is the advantage

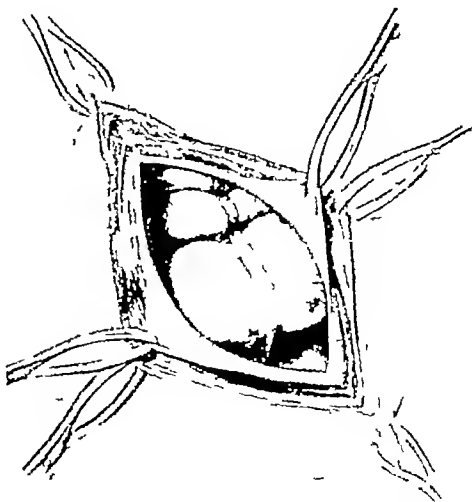


Fig 3 The muscle-cutting incision completed, and the cut edges of the peritoneum retracted showing the wide exposure of the cecal region obtained.



FIG. 4. A typical acutely abscessed and inflamed appendix lying in the extracecal position. Note the exposure obtained simply by slight withdrawal of the cecum. The small intestine is not seen.

of this posterior drainage limited to that of a dependent opening. Important as this is, but it allows of a complete closure of the anterior portion of the wound and avoids contact of pus with it, two of the most important preventives of hernia through the cicatrix.

The cecum presents (Fig. 3) and, in cases in which the appendix is extracecal in position, it may be seen and actually removed without even having to withdraw the cecum into the wound (Fig. 4). When the necessity of withdrawing the cecum arises to permit of the best exposure of the appendix, as it does in most cases, this procedure can usually be done with ease and, when combined with gentle traction forward, results in an exceedingly good exposure of an appendix in the retrocecal position (Fig. 5). For the removal of the deeply buried type of retrocolic appendix, it is difficult to conceive of an incision better suited to this purpose: the ample space it provides permits the cecum and ascending colon to be withdrawn forward and upward, thus exposing more and more of the appendix as its distal portion is released. The removal of such an appendix can thus be effected through this incision with an ease impossible of attainment through incisions such as the McBurney or paramedian. When the appendix lies in these situations, or in the subcecal position, it is often possible to remove it without even seeing the small bowel. The removal of the appendix through this incision is therefore often a virtually extraperitoneal operation and this is even more striking when adhesions around the



FIG. 5. A retrocecal appendix illustrated to demonstrate the excellent exposure obtained by lifting up the cecum. The small intestine is not seen. This illustration also indicates all the efficacy of the exposure obtained by this incision in cases in which the appendix is of the deeply buried retrocolic type.

appendix and cecum have already excluded this area from the general peritoneal cavity. Under these circumstances the appendix can usually be removed without disturbing these adhesions and so opening into the peritoneal cavity proper. At this juncture attention is drawn to the advantage of this incision in the treatment of localized appendix abscesses: through it, these can be opened and drained on their outer aspect without fear of breaking down the protective adhesions which are preventing the spread of infection in the peritoneal cavity. The risk of attempting drainage through more medial incisions needs no comment.

When the appendix lies in the so-called floccal position, pointing upward and to the left behind the terminal ileum, withdrawal of the terminal 2 or 3 inches of ileum together with the cecum increases the exposure (Fig. 6) and is helpful in those cases in which the adhesions holding down the distal end of the appendix are of such density that their separation under direct vision is felt to be advisable. This same maneuver is alone often sufficient to deliver a pelvic appendix into the wound.

The incompletely descended cecum is an abnormality which while ordinarily only of embryological interest assumes a surgical importance when the appendix has become the seat of an acute inflammation. In such a case it will be

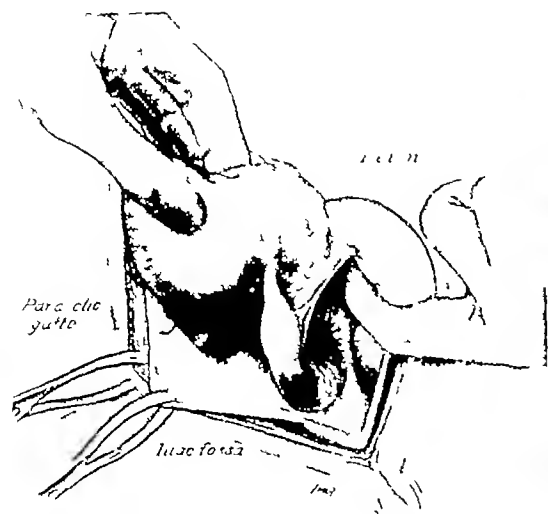


Fig 6 Appendix in ileocecal position. The cecum is withdrawn laterally, resulting in the terminal 2 or 3 inches of ileum appearing in the wound. The ample room provided by this incision, as indicated here, allows of the delivery of the appendix into the wound with a minimum of trauma and diminishes the difficulties inherent to its removal.



Fig 7 Gangrenous terminal ileum, cecum, ascending colon, and right half of transverse colon resected with ease through an oblique muscle-cutting incision of average length. The condition of the bowel was due to strangulation by a tight band. This illustration is used to exemplify how a lesion in the right side of the abdomen, other than acute appendicitis, can be dealt with in a satisfactory manner through this incision.

found that the position of the muscle-cutting incision and the ample room provided by it allow the appendix to be dealt with easily when its removal could be accomplished only with the greatest difficulty through an incision of the muscle-splitting or paramedian types.

Because of the fact that acute appendicitis can be closely simulated by other conditions, it is unlikely that there is any surgeon who has not on occasion experienced the chagrin of mistaken diagnosis, for the "acute appendix" may prove to be, not acute appendicitis at all, but some other pathological condition in the right side of the pelvis, the lower ileum, cecum, or ascending colon. Faced with such a situation, the surgeon using the muscle-cutting incision will find in the first place that this incision affords enough room to enable him to make the exploration which is necessary to establish the correct diagnosis—contrast this with the muscle-splitting incision—and secondly, that any such pathology can be dealt with conveniently and satisfactorily through this incision, although sometimes it may be advantageous to extend it medially—an easy matter made easier by remembering to divide the deep epigastric artery between forceps to prevent retraction of its cut ends with resulting troublesome hemorrhage. Ample room is provided for such procedures as removal of a twisted ovarian

cyst, ruptured ectopic gestation, or inflamed Meckel's diverticulum, lateral anastomosis between ileum and transverse colon, and even for formal resection of the right half of the colon for carcinoma of the cecum when operation has been undertaken in the belief that the tender mass felt was an appendix abscess. All these procedures have been performed successfully at various times by the writer through this incision, and Figure 7 is an illustration of another, and somewhat unusual, condition recently also dealt with satisfactorily by the same route.

The closure of the muscle-cutting incision is simple and is completed in layers like that of abdominal wounds in general. In clean cases the writer uses continuous sutures for the muscles but when drainage is employed those of the interrupted type are preferred.

One tribunal before which any abdominal incision finds itself is that relating to its liability to subsequent hernia, and in this respect the incision under consideration will undoubtedly be compared at once with the muscle-splitting type. When the abdominal musculature is good and no condition is present or arises to cause increased intra-abdominal pressure of severe degree, it should be axiomatic that any clean abdominal

wound which is cut red carefully and well should never become the seat of a hernia. I regard to the muscle-cutting incision. It has been the experience of the writer first that this axiom is borne out in clean and uncomplicated cases and second, that should infection of the wound occur then the chances of development of a hernia are just as great in one type of incision as in the other. There are those who believe that an indirect inguinal hernia may be a late sequel of the muscle-splitting incision because of damage to the ilio-inguinal nerve as it runs its course through the internal oblique at right angles to the line of separation of the fibers of this muscle. In the muscle-cutting incision this muscle is incised parallel to the course of this nerve and injury to it is avoided.

#### SUMMARY

The oblique muscle-cutting incision is described and illustrated.

The numerous advantages to be gained from the use of this incision in acute appendicitis may be summarized as follows:

1. It affords an excellent exposure of the cecal and appendicular regions and provides ample room for surgical manipulations; these features permit removal of the appendix to be accomplished with minimal trauma to both wound and bowel.

2. The posterior end of the peritoneal opening being near the level of the floor of the paracolic gutter and iliac fossa permits the establishment of a drainage—whenever this procedure is considered necessary or advisable—which is dependent and therefore efficient.

3. In every case the cecum is approached from its outer side; the advantages of this approach are obvious in that (a) The small bowel is either not interfered with at all or to a minimal degree, thus diminishing the possibility of spreading infection throughout the general peritoneal cavity and of postoperative paralytic ileus. (b) It renders the incision ideal in cases in which the appendices

In the extracecal or retrocecal or retrocolic positions. (c) When inflammatory adhesions have shut off the appendix and cecum from the general peritoneal cavity the appendix can be removed without breaking down or disturbing these protective adhesions. (d) The operation often a virtually extraperitoneal procedure. (e) Localized abscesses can be opened and drained through their outer aspect without fear of spread of infection into the general peritoneal cavity.

4. In the event of symptoms being due to surgical pathology in the right side of the abdomen or pelvis other than acute appendicitis, the incision provides room enough to make the exploration necessary to establish the correct diagnosis and to enable the surgeon to deal satisfactorily with whatever pathology is present.

5. Hernia formation does not follow the use of this incision in clean and uncomplicated cases provided the closure of the wound has been done carefully and well. Should the wound become infected, the incidence of hernia following this incision is no greater than that following other incisions used in acute appendicitis.

#### CONCLUSION

The many advantages enumerated, to be gained by the use of the oblique muscle-cutting incision whenever operation is undertaken upon the acutely inflamed appendix have led the writer to hold the opinion that it is the incision of choice in acute appendicitis and they appear to him also to justify the plea he now makes for its more frequent adoption in the operative treatment of this condition.

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# THE TREATMENT OF TRIMALLEOLAR FRACTURES OF THE ANKLE

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SIR ASTLEY COOPER(1) in 1822 first described fractures of the ankle with involvement of the posterior lip of the tibia. In the following century so many excellent descriptions appeared that Ashhurst and Bromer, in their review of the literature on ankle fractures from the time of Pott (1769) to 1922, remarked "it was with surprise that surgeons

saw Cotton (4, 1915) describe this fracture as 'a new type of ankle fracture which has never been adequately described in print and has apparently escaped the notice of those who deal with fractures habitually.'" However, Cotton's description did stimulate interest in this particular fracture and perhaps ultimately led to a more careful consideration of the special problem it presents. Cotton's (4) attention was first directed to trimalleolar fractures—which occasionally but erroneously bear his name—through old malunited cases that came to him for reconstructive surgery. He concluded that unless the fracture with its attendant posterior dislocation is recognized and reduced, "we have to reckon with the meanest and most serious lesion that occurs at the ankle joint." Six years later Cotton (5) published a description of his method of treating the fracture in its fresh state. This consisted of closed reduction by manipulation and application of a plaster cast.

The posterior lip of the tibia was entitled the "posterior malleolus" by Destot in 1911, and Henderson and Stuck in 1935 suggested the term "trimalleolar" for ankle fractures involving the medial and lateral malleoli and the posterior lip of the tibia, or "posterior malleolus." Even though the posterior lip of the tibia, anatomically, is not a malleolus, we believe "trimalleolar" is a convenient descriptive term, and for this reason despite its obvious misapplication, use it to indicate these fractures.

In 1922 Lounsberry and Metz discussed trimalleolar fractures, as well as those with involvement of the anterior tibial lip and were the first to advocate open reduction and internal fixation of the posterior or anterior tibial fragments. They

used autogenous bone pegs as the fixative agent.

Since this time, much has been written on the subject and the one notable thing about this considerable literature is the variety of different treatments proposed for trimalleolar fractures. Beck, Deuticke, Key and Conwell, Speed, and others agree that open reduction and internal fixation of the posterior tibial fragment often is necessary when the fragment is *large*. However, just what these authors mean by *large* remains moot, and just how *large* is *large* no one seems to agree. According to illustrative roentgenograms in various reports *large* may vary from less than one-quarter to about three-quarters of the anteroposterior measurement of the inferior tibial articular surface.

Hubmann, Boehler, and Murphy contend that open operation is never indicated and claim uniform success for their manipulative or combined manipulation-traction methods. Boehler and Hubmann use manipulation with three-directional traction by means of adhesive tape or a Kirschner wire through the os calcis with the leg on a Braun frame. Murphy and several others recommend only manipulation followed by the application of various plaster casts.

Dieterle and Felsenreich describe percutaneous nailing by means of single or multiple Kirschner wires to impale the fragment and hold it in position.

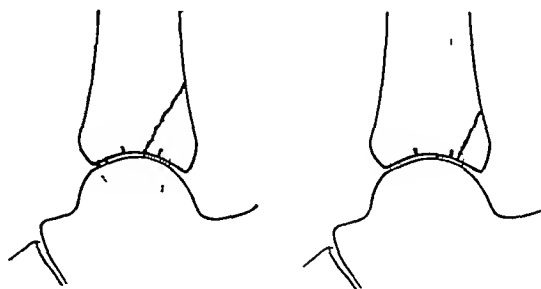


Fig 1 a, left, The "classical" trimalleolar fracture. The posterior fragment involves one third or more of the tibial articular surface. b, The "minimal" trimalleolar fracture. The posterior fragment involves less than one-third of the tibial articular surface.

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Fig. 2. a. Anteroposterior and lateral roentgenograms of a minimal trimalleolar fracture. Note the posterior dislocation of the foot, of the ankle joint and the posterior fragment which is less than one-third of the tibial articular surface. b. Roentgenograms of the same fracture which were made after reduction had been carried out. The reduction was obtained by simple manipulation. Although the posterior fragment is not anatomically replaced, the medial and lateral malleoli are and the patient has painless ankle, normal motions, and no disability.

MacKinnon adopts a rather hopeless attitude in that he regards fusion of the ankle joint as the procedure most likely to give the best result, while isolated case reports, Storey, offer the use of pillow splints and immediate active motion.

#### FIVE YEARS OF ANKLE FRACTURES AT MINNEAPOLIS GENERAL HOSPITAL

In the 5 year period ending July 1939 359 ankle fractures were treated at the Minneapolis General Hospital (Table I). In this series there were 77 minimal and only 6 classical tri-

malleolar fractures. These terms were coined by one of us (M. C. N.) only as a convenience in description and to indicate variation in degree of the particular fracture. They are not separate or different fractures but merely different degrees of the same fracture. By classical trimalleolar we mean one in which the posterior fragment involves *at least one-third of the articular surface of the distal end of the tibia* (Fig. 1a). Since coining this term, we have found basis for it in the literature in that Tilgner called the posterior fragment in a trimalleolar fracture the *classic fragment*. In contrast to classical we use minimal to indicate involvement of *less than one-third of the tibial articular surface* (Fig. 1b).



Fig. 3a. Anteroposterior and lateral roentgenograms of a "lateral" trimalleolar fracture. Note the posterior dislocation of the foot, of the ankle joint and the posterior fragment which is greater than one-third of the tibial articular surface.



Fig. 3b. Roentgenograms of the same fracture after attempted reduction by all accepted methods except open operation. The patient has only one-third normal motion in the ankle joint and is permanently partially disabled. Moreover the ankle is painful.

TABLE I — ANALYSIS OF 359 ANKLE FRACTURES

Type of Fracture	Number	Percentage of Total
Lateral malleolus alone	141	39.2
Lateral malleolus with posterior tibial lip	33	9.2
Posterior lip of tibia alone	14	4.0
Bimalleolar	50	14.0
Medial malleolus with posterior tibial lip	10	2.8
Medial malleolus alone	24	6.6
Trimalleolar—Classical	10	2.8
Minimal	77	21.4

## MINIMAL TRIMALLEOLAR FRACTURE

These 87 trimalleolar fractures were treated by several surgeons using various standard methods with uniformly good results in the "minimal" cases. Simple manipulation with the knee flexed to a right angle, and application of a plaster cast from the toes to the knee, in the great majority of cases accomplished and maintained reduction. Follow-up study on many of these "minimal" cases disclosed that complete replacement of the "posterior malleolus" is not necessary for an excellent clinical result if the medial and lateral malleoli are accurately reduced. This no doubt is due to the greater width of the anterior portion of the talus, thus preventing posterior luxation of the foot (Figs 2a and b). The larger the posterior fragment, the more accurate the reduction must be, and in "classical" cases, the reduction must be anatomically perfect before one can expect a good result.

## CLASSICAL TRIMALLEOLAR FRACTURE

The 10 cases of "classical" trimalleolar fracture were studied very carefully, and we were



Fig 4 Roentgenograms of another "classical" trimalleolar fracture after open reduction and internal fixation with one vitallium screw. The patient has normal motions at the ankle and subastragalar joints, no pain and no disability.

able to do follow-up work on 8 of them. Mrs C H was the first case of "classical" trimalleolar fracture treated by the authors at the Minneapolis General Hospital. Manipulations, casts—short, long, with foot in plantar flexion and in dorsiflexion, with knee extended and with knee flexed—three-directional traction according to Boehler, and manipulation with the extremity in traction failed to obtain reduction. The end-result was painful and disabling for our patient (Figs 3a and b).

This experience stimulated us to search for a better means of handling these difficult cases. Accordingly, when manipulation and plaster cast obtained but failed to maintain reduction in the

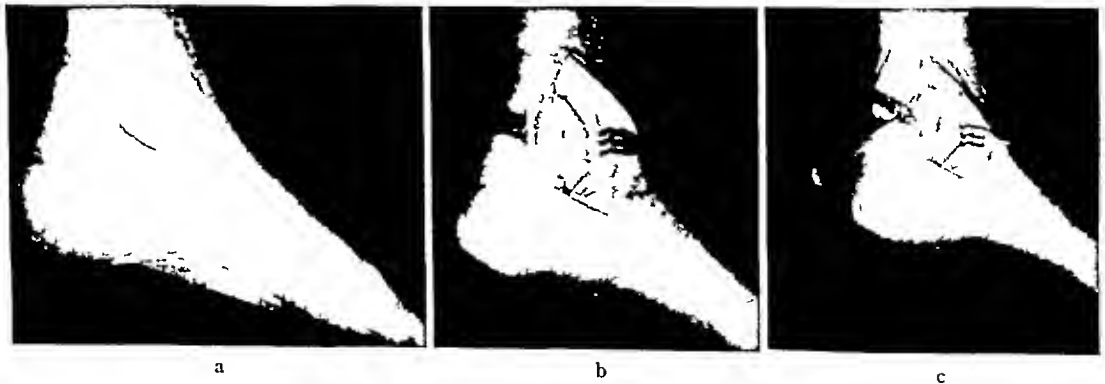


Fig 5 a, Photograph showing the incision which is used in the open operation for "classical" trimalleolar fracture. b, The dissection is carried deeper in such a manner as to show the retraction of the vessels, nerve, and tendons and to give exposure of the posterior fragment of the fracture.

c, The posterior fragment is shown as it is being fixed in place by vitallium screws after the cortex of the fragment has first been drilled. It is necessary that the screws extend through the entire width of the anteroposterior diameter of the tibia.





Fig. 3a. The bones of the leg in traction apparatus illustrate our method of obtaining three directional traction. The line through the tibial tubercle affords traction upward in line with the long axis of the tibia, the line through the os calcis affords traction downward in line with the tibia, and the line through the metatarsals affords traction forward in line with the long axis of the foot.

case of Mrs. A. M. we did an open reduction and fixed the posterior tibial fragment in place by means of a vitallium screw with excellent results (Fig. 4). In doing this operation, we use a curved incision with the concavity forward, similar to

that of Speed. The incision begins 8 to 10 centimeters above the tip of the medial malleolus and just medial to the tendo Achillis posteriorly and extends downward to a point level with the tip of the medial malleolus and then curves forward below the medial malleolus. The incision is carried through the subcutaneous tissues by sharp dissection, the posterior tibial vessels and nerve and the tendo Achillis retracted posteriorly and laterally and the tendons of the flexor hallucis longus, the flexor digitorum longus and the tibialis posterior medially and anteriorly if necessary thus exposing the fracture. The posterior fragment is easily and anatomically replaced and securely held by means of one or more vitallium screws. The screw must extend through the entire width of the bone. Preliminary drilling of the posterior tibial fragment after it is reduced makes its fixation very easy. The skin is closed with interrupted silk sutures and dry dressing is applied. The ankle is then manipulated to obtain reduction of the fractured lateral and medial malleoli and a cast is applied exactly as one does in treating a "minimal" tri-malleolar fracture (Figs. 3a, b and c).

Mrs. M. S. fortunately obtained a similar happy result through three pin cast in which three directional traction was exerted by means of Kirschner wires through the tibial tubercle, the os calcis, and the heads of the metatarsals to obtain reduction, and the reduction maintained by imbedding these wires in a plaster cast.

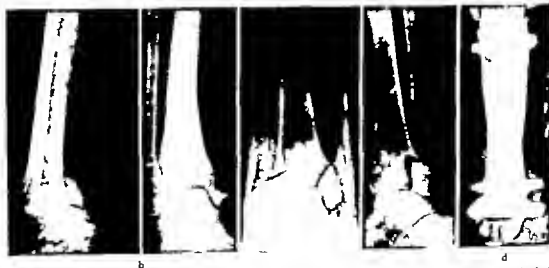


Fig. 4. a, b, Anteroposterior and lateral roentgenograms of a comminuted tri-malleolar fracture which were taken before reduction by means of three-pin cast was carried out.

c, Roentgenogram of the same fracture after reduction had been accomplished. d, A photograph of the cast showing the three pins which are imbedded in the plaster.

tending from the toes to the knee (Figs 6 a, b, c, and d)

A two-pin mechanical distraction apparatus was used in this procedure, which is difficult and requires much assistance. In the fourth and last patient treated by us, manipulation as well as the three-pin cast were unsuccessful, and open operation was again necessary. At operation we found the posterior ligaments or the joint capsule completely torn loose so that the fragment was practically free. Here then is a case—proved—in which open operation is unavoidable. The remaining cases were subjected to various treatments by surgeons of long experience, with unfavorable outcome. We believe that the fault here lies with the methods and not with the operators.

It is most significant in this problem that while over one-third of all ankle fractures have involvement of the posterior lip of the tibia, 93 per cent of these fractures can be successfully treated by exactly the same manipulative methods universally successful in bimalleolar fractures. Only 7 per cent of these fractures offer any real problem. These are the trimalleolar fractures with the posterior one-third or more of the distal tibial articular surface split away. Failure to recognize that this fracture demands a different therapeutic approach from a trimalleolar with a large fragment but less than one-third will lead to disaster. In not a single instance did we fail to get good reduction by manipulation in the "minimal" trimalleolar fractures, conversely, not one "classical" trimalleolar fracture was successfully treated by simple manipulation and immobilization. Hence it is imperative in every trimalleolar fracture with a large fragment posteriorly to ask: Is it a "minimal" or a "classical" trimalleolar? Ofttimes this involves measuring the fragment with a millimeter rule. Then, if the posterior fragment is one-third or more of the tibial articular surface, simple manipulation and application of a cast is worse than useless because of trauma incident to the procedure which may prohibit necessary open operation later. These cases must be treated either by immediate open operation or three directional traction which can be obtained in several ways. By a cast which is appropriately "windowed" to allow application of pressure to hold the foot forward ("push" instead of "pull"), by skin or skeletal traction with the leg on a Braun frame, or by a three-pin cast.

#### CONCLUSIONS AS TO TREATMENT

1 "Minimal" trimalleolar fracture is a trimalleolar in which the posterior tibial fragment comprises less than one-third of the anteroposte-

rior measurement of the distal articular surface of the tibia. It can in every case be adequately reduced by manipulation under anesthesia with the knee flexed to 90 degrees, and reduction maintained by a plaster cast from the toes to the knee with the foot flexed to a right angle and in mid-position as regards inversion and eversion.

2 "Classical" trimalleolar fracture is a trimalleolar in which the posterior tibial fragment comprises one-third or more of the anteroposterior measurement of the distal articular surface of the tibia. It can be reduced by manipulation, but the reduction cannot be maintained in every case, even if the cast extends from the toes to the groin with the knee held in 90 degrees flexion. Therefore, it should be opened, preferably within the first few hours when the skin is still in good condition and swelling absent or minimal. We use Speed's incision—just to the medial margin of the tendo Achillis and vitalium screws to fix the fragment in place. A light dressing is applied, the ankle manipulated to reduce the fractures of the medial and lateral malleoli, and the leg is placed in plaster exactly as for the minimal fractures.

3 In some cases of "classical" trimalleolar fracture, three directional traction in a plaster cast will obtain and maintain reduction, but, because this is uncertain, we believe that it is better to operate immediately. Repeated manipulations, manual or combined with skeletal traction, traumatize the skin and by so doing very frequently preclude any open surgery.

#### SUMMARY

Trimalleolar fracture of the ankle was first described by Cooper over a century ago.

"Classical" trimalleolar is the most difficult of ankle fractures to treat and probably also the most poorly treated. Open reduction and internal fixation was first advocated by Lounsberry and Metz in 1922.

"Minimal" trimalleolar is a common ankle fracture and can be reduced by manipulation and the reduction maintained by a plaster cast. Considerable offset of the posterior fragments does not preclude a good result.

"Classical" trimalleolar is an infrequent but very serious ankle fracture, it is best treated by very early open operation followed by manipulation.

Dr. A. A. Zierold, professor of surgery at the University of Minnesota and chief of the surgical service at the Minneapolis General Hospital, showed constant interest and gave helpful suggestions in the conduct of this study. Mrs. Josephine Poehler of the Department of Social Service of the Minneapolis General Hospital, and Miss Linnea Sunberg, assisted greatly in follow up studies.

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# CARCINOMA OF THE BREAST

## Report of Four Hundred Eighteen Cases

Treated at St. Luke's Hospital from 1922 to 1933

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**T**HIS series of 3 men and 415 women with primary carcinoma of the breast was treated in the Out-Patient Department and Wards of St. Luke's Hospital during the 12 year period from 1922 to 1933, inclusive. Patients with recurrences following treatment elsewhere and private patients have been excluded as unsuitable. Otherwise this is a totally unselected group and includes every patient with carcinoma of the breast who was treated either medically, radiologically, or surgically, during this period (Table I). No patient was turned away, without treatment, as hopeless. This group of patients, therefore, cannot be compared statistically to selected groups of patients such as those treated by surgery, surgery and irradiation, or irradiation alone. It is believed, however, that a study of this type gives a truer picture of the treatment of breast cancer than will the study of a group of selected, and therefore probably more favorable, cases.

### DIAGNOSIS

The diagnosis in the 374 patients operated upon has been confirmed in every case by histological study, and permanent slides are available in all but 2 instances. In these 2 latter cases, frozen section diagnoses of carcinoma were made, radical operations were performed, and both patients subsequently died of their disease. They have, therefore, been included as true cases of carcinoma of the breast.

Although histological grading has not been routinely done in these cases, we are of the opinion that the biology of the growth, as perhaps at least partially indicated by its histological appearance, ranks with treatment as the major determining factor in the outcome of each case.

In the 44 apparently hopeless cases in which patients were treated without operation in the wards and in the radiotherapy department, the diagnosis was made from the clinical appearance of the tumor and the clinical course of the disease. All doubtful cases, especially those who outlived the normal expectancy of their disease, have been eliminated.

From Surgical Division B, St. Luke's Hospital

*Clinical diagnosis of node involvement.* In 299 cases in which there is a record of examination of the axilla before operation and in which there was also postoperative histological study of the axillary nodes, a correct clinical diagnosis of involvement or uninvolved was made in 197 cases, or 65.8 per cent. In 23 cases, or 7.7 per cent, they were incorrectly called "involved" and in 79 cases, or 26.5 per cent, incorrectly called "uninvolved." The error, therefore, in the clinical diagnosis of involvement or uninvolved of the axillary lymph nodes in this series was 34.2 per cent.

### DURATION OF THE DISEASE BEFORE OPERATION

A history of the known duration of the disease on the part of the patient is available in 341 cases in which the axillary nodes were also studied histologically. Analysis in these cases according to node involvement and 5 year cures obtained is shown in Table II. With the exception of the 100 per cent axillary node involvement observed in patients who were known to have had their tumors 3 or more years, it cannot be demonstrated from this series that delay in seeking treatment had any effect either upon the percentage of axillary node involvement or upon the 5 year cures obtained. This simply emphasizes the fact that breast carcinomas, when they have reached the size to be accidentally discovered by patients, are in the main already "late" growths. This, however, should not discourage us from further educating both the laity and the medical profession concerning the necessity for still earlier diagnosis and treatment of breast cancer.

That patients are coming somewhat sooner for treatment is demonstrated by the fact that in the first 6 year period, from 1922 to 1927, 63 per cent of 102 patients sought treatment within a year after they had noticed a lump, while in the second 6 year period, from 1928 to 1933, 72 per cent of 149 patients sought treatment within a year.

### AGES

The ages of 360 patients have been analyzed to see what effect this had on node involvement and

TABLE I.—SYNOPSIS OF DATA OF ALL PATIENTS TREATED

	Number	Per Cent
Radical mastectomies	35	
Simple or incomplete mastectomies	3	
No operation	44	
Total number of cases	48	
Postoperative hospital deaths	4	3.7 <sup>1</sup>
Axillary node involvement	244	65.3
No axillary node involvement	6	3.0 <sup>1</sup>
No record of axillary node involvement	58	3.8 <sup>1</sup>
Lost to follow-up under five years	43	3 <sup>1</sup>
Dead under 5 years	3	
Dead in first year	78	
Dead in second year	58	
Dead in third year	43	
Dead in fourth year	35	
Dead in fifth year	9	
5 year survivals	39	30.8 <sup>1</sup>
With axillary node involvement	57	3.3 <sup>1</sup>
Without axillary node involvement	68	58.6 <sup>1</sup>
No record of nodes	4	
Ten year survivals	44	6.6 <sup>1</sup>
With axillary node involvement	7	0.9 <sup>1</sup>
Without axillary node involvement	37	58.0 <sup>1</sup>
Known local recurrences	66	6.0 <sup>1</sup>
In patients with involved nodes	5	5 <sup>1</sup>
In patients without involved nodes	8	6.0 <sup>1</sup>
Bilateral mastectomies	6	4

<sup>1</sup>Of 37 patients operated upon

<sup>2</sup>Of all patients

<sup>3</sup>Of 44 patients with axillary nodes

<sup>4</sup>Of 24 patients without axillary nodes

<sup>5</sup>Of 68 patients treated from 1922-1935

<sup>6</sup>Of 38 patients with axillary nodes

<sup>7</sup>Of 4 patients without axillary nodes

5 year cures and are shown in Table III. From this table it can be seen that of the patients in their twenties, 1 or 91.6 per cent showed node involvement and that only 3 or 6 per cent survived 5 years after operation. After 30 years of age age apparently had little effect either on the node involvement or the five year survival rate.

#### BIOPSIES

Biopsies in our cases were taken by the surgeon with the patient on the operating table and draped for the radical procedure. Needle or punch biopsies were not used as we are opposed to them on theoretical and practical grounds. Theoretically we think that it is an unsound practice to needle malignant tumors of the breast or metastatic carcinomas in the axillary lymph nodes and wait several days before radical surgery when other more direct means of obtaining material for histological diagnosis are available. The introduction of a needle large enough to secure cells for histological study must produce undesirable trauma and hemorrhage not only in the growth itself but also along the line of puncture. While we are willing to admit that in specially

TABLE II.—RELATION OF KNOWN DURATION OF DISEASE BEFORE OPERATION TO AXILLARY NODE INVOLVEMENT AND 5 YEAR SURVIVALS

Known duration of disease	Number of cases	% axillary involvement	Per cent with axillary involvement	Five year survival	Per cent of 5 year survival
0-6 months	100		47.8	33	33
6-12 months	60	74	60	26	43.3
1-2 years	24	9	79.2		37.5
2-3 years	15		73	8	53.3
3-4 years			3		33
4-5 years			100		15
5-7 years	6		100		16
7+ years			100		60
TOTALS	241	24		7	

trained and unusually competent hands, both of the surgeon and of the pathologist, punch and needle biopsies are probably satisfactory we think that the teaching of this method as sound practice for routine use should be discouraged. Patients are repeatedly seen who have had tumors needled by variously trained physicians and surgeons without the securing of proper material for histological study and without arriving at a definite diagnosis. Knowing the difficulty one sometimes has in securing adequate tissue for operation from very small growths hidden in a fatty breast, it is hard to see how needle biopsy from such a breast can be accepted with any confidence. Our contention is that in any case surgery is necessary. In the first instance in which the biopsy is negative surgery is necessary to demonstrate that tumor has not been missed by the needling and in the second instance in which carcinoma is found, immediate radical surgery is indicated. Therefore it appears that needling may be dangerous and in any case it is unnecessary and useless procedure.

#### OPERABILITY

Radical mastectomies were performed by 20 different surgeons on 351 patients, and simple mastectomies, or otherwise incomplete operations, were performed on 3 patients. This gives a total of 374 patients or 80.5 per cent of the entire series who were thought suitable for some form of surgical treatment. This, of course does not represent the operability of carcinoma of the breast as we see it, but simply represents the total number of patients for whom some type of surgery seemed the best therapy.

In 1938 series of 238 cases of cancer of the breast were studied at St. Luke Hospital (2)

and in this group only 144, or 60.5 per cent, were considered "operable." However, this so called rate of operability was undoubtedly too low and was too dependent upon the individual standards of the various surgeons. Would it not be wise for all clinics to abandon the "operable" and "inoperable" classification for breast cancers and simply regard all cases, both favorable and unfavorable, as patients with cancer of the breast needing treatment? In sufficiently large clinics the material will be comparable and the various methods of treatment in use can be evaluated more easily.

#### POSTOPERATIVE DEATHS

There were 14 postoperative hospital deaths, an operative mortality of 3.7 per cent of 374 patients operated upon. Postoperative pneumonia accounted for 3, wound infections, 3, cerebral hemorrhage, 2, shock, 2, and coronary occlusion, chronic nephritis with anuria, delirium tremens, and pulmonary metastases, 1 each. These patients have been included with those who have died of cancer.

#### AXILLARY NODE INVOLVEMENT

In 374 patients operated upon, the axillary lymph nodes were involved in 65.2 per cent, uninvolved in 31.0 per cent, and were not examined in 3.8 per cent. The latter group is composed mainly of patients on whom simple mastectomies were performed for advanced carcinomas. The 31 per cent of uninvolved nodes is therefore the more significant figure.

#### IRRADIATION

Pre-operative irradiation has not been used in any case in this series for 2 reasons: (1) because this method of treatment was not being used to any extent during the years 1922 to 1933 when this group of cases was seen and (2) because we are not convinced that it is a desirable method of treating breast carcinoma. Adair, who has had a large experience with pre-operative irradiation, furnishes us with the following list of its practical disadvantages, (1) pulmonary fibrosis, (2) poor wound healing, especially separation of wounds, (3) increased technical difficulty of performing the operation after irradiation, (4) increased incidence of postoperative edema of the arm, and (5) fibrosis of the arm muscles with limitation of use. In order to recommend a method of treatment with these known, undesirable results, there must be some well known and proved advantages to offset them. This, to our knowledge, cannot be found in the literature.

TABLE III — RELATION OF AGE OF PATIENTS TO AXILLARY NODE INVOLVEMENT AND 5-YEAR SURVIVALS

Age of patients in years	Total number of patients	Number with axillary node involvement	Per cent of axillary node involvement	Five year survivals	Per cent of 5 year survivals
20 to 29	12	11	91.6	2	16.6
30 to 39	40	28	70.0	15	37.5
40 to 49	132	88	66.6	49	37.1
50 to 59	89	62	69.6	24	26.9
60 to 69	70	46	65.7	31	44.3
70 to 79	16	8	50.0	4	25.0
80 to 89	1	1	100.0	0	0
Totals	366	244		125	34.7

The chief argument which is advanced for pre-operative irradiation is that the operative field can either be sterilized of tumor cells or that the fibrosis around the tumor cells will be so great that the risk of dissemination during the radical mastectomy will be greatly decreased. Concerning the first argument, there is no evidence to show that in even half of the cases the breast can be devitalized of its cancer cells by pre-operative irradiation. In 200 cases reported by Adair, complete disappearance of the tumor was obtained in 47, or 23.5 per cent, and in 104 cases with axillary node involvement, sterilization of the axilla was accomplished in 8, or less than 8 per cent of the cases. We feel that a quicker and by far surer way to sterilize a person of carcinoma of the breast locally is to remove the breast and axillary contents as soon as the diagnosis of malignancy is made. It must always be borne in mind, however, that no method of treatment will be curative once the disease has spread outside the local field.

That the spread from tumors during radical mastectomy following pre-operative irradiation is diminished or completely eliminated, is purely theoretical. Our objection, therefore, to this argument is also purely theoretical. We do not believe that the traumatic spread of cancer of the breast during a radical mastectomy which is carried out in a careful and gentle manner is a factor in the cure of this disease. We have a much firmer conviction that the trauma of every day life, including dressing and bathing, which is daily sustained during a course of pre-operative irradiation and the period of waiting which follows, has much more to do with spread of cancer of the breast than has the manipulation of surgery.

Postoperative irradiation of varying amounts and administered over varying periods of time was given to 305 patients. In 38 of these cases only a few light treatments were given and it is felt that they had no effect, while in the 167 instances remaining larger amounts were given and over longer periods of time. Nine patients began their irradiation after local recurrences were manifest and 166 patients received routine postoperative prophylactic treatment. Thirty-six of the latter group subsequently developed local recurrences. Definite improvement of skin recurrences following irradiation was noted in many instances, no improvement in some, and ulceration without improvement in a few. In one case a squamous cell epithelioma developed on the base of an x ray dermatitis. There is no case however in this series in which a patient with a local recurrence either in the skin or axilla has been cured of her disease either by surgical excision of the recurrence by excision and prophylactic irradiation, or by irradiation alone. All patients, except one with locally recurrent carcinoma are known to be dead of their disease; the one surviving patient has passed the 5 year period but has evidence of distant metastases. This does not mean that recurrences should not be treated but merely emphasizes the fact that the curability of cancer of the breast is dependent upon its primary local eradication and that any form of primary treatment is inadequate which does not have complete eradication as its objective.

Postoperative irradiation rarely cures and usually does not prevent local recurrences and therefore does not decrease the mortality from cancer of the breast. It does, however undoubtedly prolong some lives so that a few patients who would otherwise have died within 5 years after operation have survived several more months to be classed in the 5 year group. In this respect postoperative irradiation may possibly add 5 per cent to the 5 year survival rate of breast cancer. The 10 year survival rate is, however probably not influenced by postoperative irradiation.

#### BILATERAL OPERATIONS

Bilateral mastectomies, either simple or radical, were performed upon 16 patients at varying intervals of time giving an incidence of operable bilateral involvement of 4 per cent in the 374 patients operated on. Only 2 of these patients are alive at the present time: one is living with pulmonary metastases, and 4 years respectively after the radical removal of the right and left breasts, while the second is living with local

recurrences 10 years after the removal of the first breast and 18 months after the second radical operation. The low rate of curability in this group suggests that in many cases involvement of the second breast is metastatic rather than primary.

#### FOLLOW UP

The end-results are known in 375 or 89.8 per cent, of the 418 cases. During the first 6 year period from 1922 to 1927 34 patients were lost to the follow up while in the second 6 year period, from 1928 to 1933 only 9 patients were lost. While a few untraced patients have undoubtedly survived we believe that the great majority have succumbed to their disease. This certainly has been the history of so called lost patients whom we have recently located. In the great majority of instances it was found that they had either died here in New York City or had returned to homes in other parts of the United States in anticipation of death. Few patients went to Europe within 5 years after operation and have not been traced. So far then, as the end-result statistics are concerned, we re-perfect content to count the 43 untraced patients as dead of their disease.

#### RECURRENTS

Locally recurrent carcinoma either in the skin or axilla was diagnosed clinically in 60 or 6 per cent, of 374 patients operated upon. In 5 instances these recurrences were in patients with primary axillary node involvement and in only 8 were they observed in patients without primary axillary node involvement. This demonstrates the effectiveness of radical mastectomy in cases in which the disease has not spread to the axilla and also illustrates the fact that routine postoperative prophylactic irradiation to the axilla of patients without node involvement is probably unnecessary.

#### END-RESULTS

Of the 418 patients treated 14 died in the hospital after operation, 32 are known to be dead under 5 years, 43 were lost to follow-up under 5 years, and 29 survived the 5 year period.

Nine patients are known to have died of other conditions and free of tumor less than 5 years after operation and another 11 less than 1 year after operation. However for statistical purposes, these patients have all been considered as having died of cancer.

The 29 5 year survivals were composed of 125 patients operated upon and 1 patient with a supposedly inoperable carcinoma who was treated entirely by x-ray. This patient subsequently died of her disease so there is no doubt as

to the correctness of the diagnosis. The 129 patients, therefore, represent a 5 year survival rate of 30.8 per cent of all patients treated, while the 128 surviving surgical patients represent a 5 year survival rate of 34.2 per cent of 344 patients operated upon for both early and advanced tumors.

Five year survivals were obtained in 23.3 per cent of 244 patients with known axillary lymph node involvement and in 58.6 per cent of 116 patients without axillary node involvement. Forty-four, or 16.6 per cent, of 271 patients treated, and 17.7 per cent of 242 patients operated upon from 1922 to 1928 inclusive, survived 10 years. This group is made up of 38 per cent of 71 patients without node involvement and 10.9 per cent of 156 patients with node involvement.

#### CONCLUSIONS

1. A series of 418 unselected patients with primary carcinoma of the breast, treated at St. Luke's Hospital from 1922 to 1933, is reported. Included are 44 apparently hopeless cases treated by irradiation alone, and 374 treated by incomplete or radical surgery.

2. An error of 34.2 per cent was made in the clinical pre-operative diagnosis of involvement or noninvolvement of the axillary lymph nodes.

3. Age was not a factor either in the percentage of axillary node involvement or 5 year survival rate after the third decade.

4. Surgical biopsies secured at the time of operation were used in preference to those obtained by the needle or punch methods.

5. The axillary lymph nodes were histologically involved in 65.2 per cent, uninvolved in 31.0 per

cent, and not examined in 3.8 per cent of the 374 patients operated upon.

6. Pre-operative irradiation was not used in any case while postoperative irradiation of varying amounts and over varying periods of time was given to 205 patients. Although the latter has been of value in the control of local recurrences and pain associated with skeletal metastases, we believe that it should be given routinely after operation only to those patients with axillary lymph node involvement in whom local recurrences are more likely.

7. The end-results are known in 375 cases, or 89.8 per cent, of the entire group. Fourteen patients died in the hospital following operation, 43 were lost to follow-up under 5 years, 232 are known to be dead under 5 years, and 129 survived the 5 year period. This represents a survival rate of 30.8 per cent of all patients treated and 34.2 per cent of the 374 patients operated upon for both early and advanced tumors. With the exception of one patient living with distant metastases, all others with recurrent tumor in the skin or axilla are known to be dead of cancer in spite of local surgical or roentgen-ray therapy. This emphasizes the fact that the curability of cancer of the breast is dependent upon its primary local eradication and that any form of primary treatment is inadequate which does not have complete eradication as its objective.

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# OMPHALOCELE (UMBILICAL EVENTRATION) IN THE NEWLY BORN

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UMBILICAL hernia is a condition which is frequently encountered in childhood. In this abnormality there is a variable sized defect of the rectus fascia and muscles around the navel so that a peritoneal sac protrudes forward and is covered with skin. In a somewhat similar but rather rare malformation which we call an omphalocele there is likewise a separation of the fascia and muscles about the navel, but in addition there is absence of the skin over the bulging abdominal mass. In the omphalocele abdominal viscera are displaced forward into the umbilical cord so that the presenting intestines are covered only by peritoneum and amniotic membrane. It is evident that this latter type of abnormality is different from the common umbilical hernia and deserves special consideration because the prognosis and the methods of treatment are quite dissimilar.

Many authors have published reports of cases which they have designated as "congenital umbilical hernia," "funicular hernia of the umbilicus," "massive hernia into the umbilical cord." Indeed, some writers have confused umbilical hernia as it is commonly known with the condition which is the subject of this publication. It is important, therefore to employ some ther declarative term, as exomphalos, "eventration at the umbilicus," amniotic hernia or omphalocele for these lesions. This latter name is the one which is routinely employed in our clinic. Notes concerning omphalocele and its treatment have appeared in the literature occasionally but no one author has encountered more than 4 cases. It seemed desirable, therefore, to present a review and study of the records of 22 such cases which have been seen in the Children's Hospital.

## EMBRYOLOGICAL CONSIDERATIONS

During early fetal life the celomic cavity normally has a forward expansion into the base of the umbilical cord. In fetuses 7 to 7 millimeters long a large part of the intestinal tract is displaced anteriorly into this recess in the umbilical cord where it normally remains until some time

between the 32 to 42 millimeter stage. Observations vary concerning the exact time during which the intestines enter and leave this forward extension of the celomic cavity but for practical purposes it may be said that they normally occupy this position from the sixth to the tenth week of fetal life (Fig. 1). The exact reason for this protrusion is unknown. Most authors agree with the morphological observation of Mall (7) that just prior to the extrusion of the intestines there is marked enlargement of the liver. Therefore, the liver appears to take up so much space in the body cavity that the bowel is forced out into the expansible umbilical portion of the coelom. Subsequently the lower abdominal cavity grows at an accelerated rate and the intestines are then drawn back within its confines.

The formation of an omphalocele in the newly born child is probably related to an arrest or retardation in development of the abdominal cavity during the third month of fetal life. Thus, if the lower abdomen does not grow fast enough at this period, some abdominal viscera will remain in the base of the umbilical cord, because there is insufficient room for them to return to the abdominal cavity.

Other theories have been advanced as the cause of an omphalocele but these have had little general acceptance. Ashoff suggested that persistence of the omphalomesenteric duct would hold the bowel out in the cord and hence the abdominal wall could not normally close at the navel. The presence of the omphalomesenteric duct or its remains (Meckel's diverticulum) has been demonstrated more frequently in these cases than in normal individuals. In support of this theory is our Case 4 in which Meckel's diverticulum opened on the side of the omphalocele sac.

Ashoff proposed that the condition was best explained by persistence of the fetal concavity of the dorsal spine.

Recently Enbom on the basis of models of human and opossum embryos, advanced the theory that the intestinal loops are withdrawn into the abdominal coelom by contraction of longitudinal smooth muscle fibers of the omphalomesenteric artery. Further studies must be made to establish the plausibility of this theory.

From the Surgical Clinic of the Children's Hospital and the Department of Surgery of the Harvard Medical School.  
This study was supported by a grant from the Gaffney Memorial Trust.

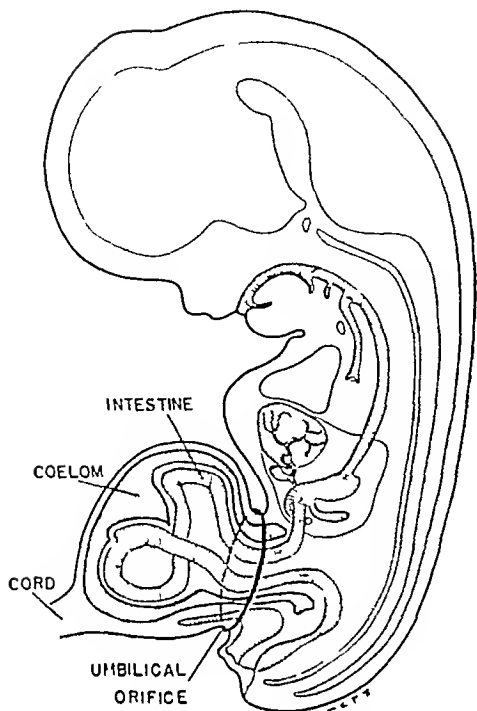


Fig 1 Sketch from a median sagittal section of a 17 millimeter human embryo, showing the digestive canal (after Mall and Prentiss). There is a protrusion of the midgut out into the expanded base of the umbilical cord. This forward displacement of intestines normally occurs at about the 10 millimeter stage and persists until about the 40 millimeter stage.

After all the evidence presented here is considered, it would appear that the simplest explanation of the etiology of an omphalocele is dependent upon a persistence of the fetal situation wherein there is a disproportion between the size of the peritoneal cavity and its contents. If after the original protrusion has taken place, the disproportion increases, then more and more viscera are pushed out of the abdomen, particularly those which have not yet attained a retroperitoneal attachment. Probably other factors are occasionally active—as suggested by the numerous other explanations—but these would appear to be of secondary importance.

There is little in the literature to suggest that in omphalocele is a hereditary malformation. None of our 22 patients had any history of a similar condition occurring in their respective families.

#### CLINICAL FINDINGS

An omphalocele is a thin walled sac at the base of the umbilical cord which may contain intestines, liver, or other abdominal organs. This sac, which varies from several centimeters to as much as 15 centimeters in diameter, has a wide communication with the abdominal cavity. It is a translucent structure composed of peritoneum internally and amniotic membrane externally, which appear to be fused when examined grossly. It is usually so thin that it has the transparency of



Fig 2 Case 9. Two day old patient with an omphalocele which contained a portion of the small intestine and a small portion of the right lobe of the liver. Sac completely excised. Patient alive and well. Arrow points to stump of umbilical cord attached to the left side of the omphalocele.

times, liver, or other abdominal organs. This sac, which varies from several centimeters to as much as 15 centimeters in diameter, has a wide communication with the abdominal cavity. It is a translucent structure composed of peritoneum internally and amniotic membrane externally, which appear to be fused when examined grossly. It is usually so thin that it has the transparency of



Fig 3 Case 9. Photograph of patient at 9 years of age showing the condition of the abdominal wall after removal of an omphalocele shown in Figure 2.



Fig. 4. Case 20. 7 day old baby with large omphalocele containing intestines, large portion of the colon, and portion of the liver. Arrow points to skin, which is growing over the omphalocele at its base. Remainder of the omphalocele has no cutaneous covering.



Fig. 5. Case 3. Large omphalocele in baby 4 months of age. After removal of the sac and replacement of the organs into the abdominal cavity great respiratory distress and circulatory collapse followed. Child died on the day of operation.

tissue paper and hence the enclosed abdominal viscera can be readily seen through it. The umbilical cord, or its remnant, is attached to the apex of the omphalocele sac, and the two umbilical arteries and the umbilical vein separate and course within the leaves of the sac to enter the abdominal wall as the hypogastric arteries and the umbilical vein. The skin of the abdominal wall usually stops just at the base of the omphalocele but in some cases it may extend up a centimeter or more onto the sac (Figs. 4 and 1).

The appearance of the sac wall varies with the age of the patient and with the care with which it has been treated by the obstetrician. When seen within the first day of life, the sac is always thin, less than a millimeter in thickness, is quite transparent, very moist and pliable. In such a case its appearance is much the same as the fetal membranes which had encased the baby. When the

child is older than one day or if there has not been a protecting moist dressing, the sac wall tends to be dry, to become less pliable, and to be opaque. This grayish membrane will crack or rupture if carelessly handled. When the child is a few days of age the sac shrivels and a portion of it may become necrotic because of the poor blood supply to its wall. Parts of the wall may then become thickened, blackened, or may rupture. At this stage the sac is often infected and cellulitis may appear along the surrounding cutaneous margins.

The size of an omphalocele mass can be judged from the accompanying figures and also by reference to the table in which the findings in our 23 cases are listed. The smallest sac which we have encountered was 4 centimeters in diameter and the largest was 15 centimeters in cross dimension with an average of about 8 centimeters. In all but 2 patients there was small intestine in the sac. In almost one half of the series some portion of the liver was outside of the level of the abdominal wall and was protruding into the omphalocele. In 5 cases more viscera were seen in the omphalocele,



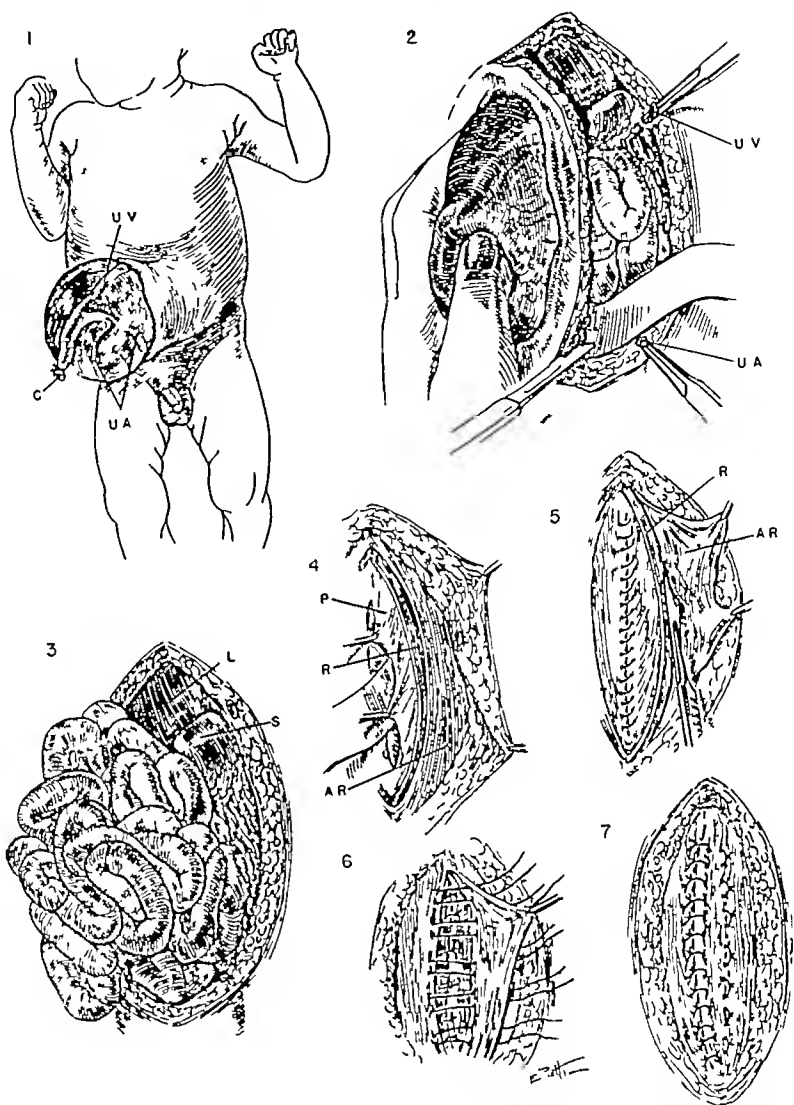
Fig. 6. Case 14. Omphalocele in 3 hour old baby which contained only loops of small intestine. Defect in the abdominal wall was very small. Arrow points to stump of umbilical cord. Surgical treatment followed by successful result.



Fig. 7. Case 14. Photograph of patient 3 days after removal of omphalocele which was shown in Figure 6.

Fig 8 Sketch of operative removal of an omphalocele 1, Position of omphalocele on abdominal wall, 2, Method of removal of the sac, cutting away a narrow rim of the adjacent skin and abdominal wall in order to freshen these edges. It is best to cut through the entire abdominal wall at one site and then continue this incision around the sac, cutting through all layers of the abdominal wall with each subsequent sweep of the scalpel or scissors. The large umbilical vein and umbilical arteries must be immediately clamped as shown, in order to avoid hemorrhage. 3, Entire sac has been removed. Umbilical vein and arteries are ligated, intestines prolapse out of the wound. 4, Intestines replaced in the abdomen, peritoneum has been freed from the overlying structures. 5, Peritoneum has been closed with a running suture. The rectus muscle and the anterior rectus fascia are now freed. 6, Rectus muscle has been approximated with interrupted silk sutures. The anterior rectus fascia, which has been freed, is brought together with interrupted mattress sutures of silk. 7, The imbrication of anterior rectus fascia is completed with interrupted silk sutures.

AR, anterior rectus fascia, C, cord, L, liver, P, peritoneum, R, rectus muscle, S, stomach, UA, umbilical artery, UV, umbilical vein



including pancreas, a Meckel's diverticulum, part of the urinary bladder, uterine tube, and spleen.

These infants rarely show any discomfort or altered physiology from having the abdominal viscera thus dislocated and possibly exposed to a lower temperature. There is rarely any respiratory difficulty. In no case have we seen obstruction of the stomach, intestine, or colon before operation. In no instance has there been jaundice or evidence of biliary obstruction, in spite of great dislocation of the liver and obvious distortion of the structures in the gastrohepatic ligament.

Associated congenital anomalies occur with more than coincidental frequency. In one case there

was a Meckel's diverticulum which opened on the omphalocele sac. Harelip was present in one child and club-feet were observed in 2 patients. Two had inguinal hernia, one had hydrocephalus, and one had multiple congenital anomalies, including transposition of viscera. One individual had an imperforate anus and two had undescended testicles. Aside from these individuals, all the others appeared to be well developed and to have no other defect.

In 19 cases there was information concerning the time of delivery of these babies. Thirteen of them were born at term, 2 were overterm, and 4 were prematurely delivered.

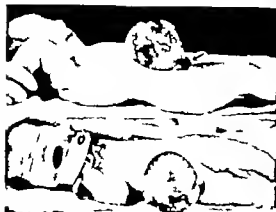


Fig. 5. Case 5. Illustration of 1 day old baby with omphalocele which contained the intestines and portion of liver. The arrow points to the stump of the umbilical cord.

#### TREATMENT

To attempt treatment in these cases by any means other than immediate surgical attack is to expose the child to the imminent risk of a fatal rupture of the omphalocele sac or a spreading infection of the abdominal wall. These babies should have surgical repair on the first day of life and preferably within a few hours after birth. Food should be withheld from the infant until after operation for collapsed stomach and intestine will make the operation easier.

In 1 of our patients the skin of the abdominal wall had started to grow up into the sac as a narrow phlange around the base of the omphalocele



Fig. 6. Case 9. Four week old child with omphalocele. There is great deal of skin growing over the lateral and superior portions of the mass, but the central part is ulcerated and infected. Subsequent death from spreading infection.



Fig. 7. Case 6. Photograph of patient showing good repair of abdominal wall 9 years after removal of an omphalocele.

(Fig. 1). This encouraged us to believe that the epidermis would continue to grow and possibly cover the entire sac. Operation was deferred, therefore in the hope that such epithelization would be complete, and replacement of intestines into the abdominal cavity and repair of the fascial defects could be done at later age. Unfortunately, however, infection supervened from which the child subsequently died. There is quite general agreement in the literature that radical operation offers practically the only hope for continued life. Conservative treatment by application of antiseptic dusting powder and alcohol compresses followed by strapping has been reported as being successful on rare occasions but this should be done only when there is some situation which contraindicates surgical procedures.

Twenty-two of these patients have entered the Children's Hospital and 20 of them have been operated upon. The attempt in each instance was to excise the sac, replace the intestines and other viscera into the abdominal cavity and to effect some repair of the abdominal wall. In the great majority of cases, considerable difficulty was encountered in pushing these viscera back into place because the abdomen had never developed sufficiently to accommodate them comfortably. The surgeon's main difficulty therefore is that of crowding intestines into cavity which is not big enough for them and also of finding sufficient tissue to close large opening in the abdominal parietes.

After the so called narrow margin of skin has been cut away, few small vessels must be ligated around the periphery of the wound but special attention must be paid to the three main vascular



Fig 12 Case 19 Two day old child with omphalocele which contained intestines and a small portion of the liver

channels which course from the sac into the abdominal wall. Thus, the hypogastric arteries must be ligated as they enter the inferolateral parts of the abdominal wall. The third vessel, the umbilical vein, usually passes along the left side of the sac and there joins the abdominal wall, where it should be tied.

After the sac is excised, an attempt is made to dissect the various layers of the wall so as to identify the peritoneum, posterior rectus fascia, the rectus muscle, and the anterior rectus fascia on each side of the wound. If sufficient care is taken these tissue planes can all be individually identified and cleared. This dissection of the various layers gives some laxness to the tissues which will be a great aid in repairing the abdominal wall. If enough laxity is present, the edges of the wound can be approximated in layers, which is the ideal procedure. The peritoneum and posterior rectus fascia are brought together with continuous fine chromic catgut of No 00 or No 000 size. The bellies of the rectus muscles should be approximated with interrupted sutures, preferably of fine silk. The anterior rectus fasciae are now approximated in the midline with interrupted silk sutures. It is desirable to imbricate the anterior rectus fascia if possible, but there is usually too much tension to allow such overlapping. If the abdominal wall has been closed without difficulty up to this stage, there is usually no problem in closing the skin, because this is always more lax than are the subjacent layers. In several cases through and through silkworm gut sutures were employed including all layers of the abdominal wall. We have not been convinced that this adds



Fig 13 Case 19 Condition of abdominal wall 2 years after removal of omphalocele shown in Figure 12. There is a muscular defect in the central part of the abdominal wall which will be subsequently repaired at a second operation.

to the strength of the wound or to the improvement of subsequent healing.

In some of the cases closure of the abdominal wall was by no means satisfactory because the great tension and the apparent underdevelopment of the abdominal wall tissues did not permit all layers to be brought together in the midline. In these patients, little more could be done than approximation of the anterior rectus fascia and the skin. In one infant the abdominal wall was so tight that only the subcutaneous fat and skin could be brought together over the defect. This baby has survived and the relatively mild weakness of the abdominal wall (Fig 13) can be easily repaired when the child is several years of age.

After the crowding of viscera into the abdominal cavity, three serious complications are apt to arise. First, the diaphragm is displaced upward



Fig 14 Case 21 Photograph of patient 2 years after removal of an omphalocele which was 10 centimeters in diameter. The abdominal wall is strong and there is no muscular or fascial defect.

DATA FROM CASES OF OMPHALOCELE OBSERVED AT THE CHILDREN'S HOSPITAL

Case	Age	Sex	Diameter of omphalocele	Contents of omphalocele				Other congenital defects	Treatment	Result
				Intestine	Colon	Liver	Other viscera			
	days	F		+	+	+	Pancreas		Fixation	Died
	hr	F	10	+		+			Excision	Died
	hr		7	+	+				Excision	Cured
	hr	M		+			Meckel's diverticulum	Meckel's diverticulum	Excision	Cured*
5	hr	F		+	+		Bladder and tube		Fixation	Died
6	dn	M	8	+					Excision	Died
7	6 days	F	8			+			Excision	Died
8	days	F				+		Club foot	Excision	Died
	days	M		+		+		Intestinal hernia	Excision	Cured
	days	F		+	+	+	Spleen		Excision	Died
	hr	M	8	+	+		Bladder	Imperforate anus	Excision	Died
	hr	M	8	+					Excision	Cured
	mo	M		+	+	+		Undescended testicle	Excision	Died
11	hr	M		+					Excision	Cured
	days	F	8	+		+		Club foot	Excision	Died
16	day	M		+				Undescended testicle born by	Excision	Cured
17	24 hr	F	10	+	+	+			None	Died
18	dn	M	6	+				Lapsoal hernia	None	Died
19	days	F	6	+		+			Excision	Cured**
20	2 hr	M		+	+			Hydrocephalus	Excision	Cured
21	6 hr	M	10	+				Lapsoal hernia	Excision	Cured
	14 hr	F		+				Transposition of viscera	Excision	Cured

\*This case was previously reported by Carter.

\*\*There remained weakness in central portion of abdominal wall which to be reported at second session.

and respiratory distress and even cyanosis may rapidly appear. Second great pressure on the inferior vena cava impedes the return of blood from the lower abdomen and legs, so that edema of the legs, circulatory collapse, and even death may supervene. Third pressure on the stomach and intestines may give rise to partial or temporary obstruction. Operative shock is usually absent or minimal, but the postoperative condition of these small patients is apt to be extremely poor due to the respiratory distress and the circulatory embarrassment.

#### PROGNOSIS AND RESULTS OF TREATMENT

If no treatment is given, death will usually result because of rupture of the thin omphalocele membrane. If this accident is not encountered, the delicate sac is apt to become infected and spreading cellulitis of the abdominal wall leads to generalized infection.

In the present series, 2 patients were not operated upon and both died. Twenty patients were operated upon: 10 of these died and 10 survived. In the living patients, 2 have weakness in the central portion of abdominal wall which should be readily amenable to later surgical treatment.

The contents of the sac have considerable prognostic importance. The presence of liver within omphalocele is a bad sign. It implies that the abdominal cavity is small, that there will be difficulty in reducing the sac contents, and that there will be considerable crowding of abdominal viscera after operation. Of 8 cases in which some part of the liver was in the sac, there were 6 deaths. If on the other hand the sac contains only small intestine there is usually less difficulty in reducing the omphalocele and the prognosis is accordingly excellent.

The size of an omphalocele has some prognostic value. In those patients with sac less than 8

centimeters in diameter, there were 75 per cent survivals. When the sac was about 8 centimeters in diameter, there were 28 per cent survivals. And when the sac was larger than 8 centimeters, the survivals were reduced to 17 per cent.

The age of the individual at operation had little to do with the subsequent outcome of the case, excepting that the older individuals were more apt to have infections in the sac and in the operative wound. Adler and Finsterer have both pointed out that the mortality is distinctly lower if operation is performed in the first 24 hours of life, presumably because infection is still minimal in this period. In 3 of our series the sac was infected, and all of these died.

In general, the observations of the surgeon have given considerable information regarding the prognosis. In 9 cases the operator noted that there was a difficult closure and that there was a high intra-abdominal pressure after closure was completed, 8 of these subjects subsequently died. The embarrassment of the respiratory and circulatory systems can well be appreciated by the fact that the 10 post-surgical deaths all occurred within 48 hours after operation. In these fatal cases the postoperative respiratory rates were from 76 to 85 per minute and the heart rates were from 130 to 160 per minute. It is evident, therefore, that little or no attempt should be made to gain an ideal closure of the abdominal wall when intra-abdominal tension is great. In such cases it is probably better judgment to close only the subcutaneous fascia and skin, allow the abdominal wall to stretch, and then repair the fascial and muscular defect 1 week later. We believe that this principle should be employed in future cases.

#### SUMMARY

The condition of omphalocele or umbilical eventration in the newly born is described. Omphalocele consists of a protrusion of some of the abdominal viscera outward into the umbilical cord so that they are covered with only a thin transparent membrane. Such an omphalocele may vary from 3 or 4 centimeters to as much as 15 centimeters in diameter. The presenting sac is not covered with skin and the thin membrane is

apt to rupture and lead to fatal evisceration. The treatment should be by early surgical repair in the first day of life before the omphalocele sac ruptures or becomes infected. The sac and a surrounding edge of skin should be cut away and the organs replaced within the abdomen. Crowding of the abdominal viscera and the deficiency of the abdominal wall usually makes satisfactory closure difficult. If the peritoneum, muscles, and rectus fasciæ cannot be easily closed, it is probably better to suture only the subcutaneous fascia and skin and then secondarily approximate the deeper layers one week later when they will have become stretched.

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# THE USE OF A TOURNIQUET IN THE REMOVAL OF TUMORS IN THE POSTERIOR MEDIASTINUM

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**I**n the removal of solid tumors of the posterior mediastinum such as those of connective tissue or neurogenic origin, it is commonly possible to reflect the parietal pleura from the growth after resection of the posterior portions of several ribs and incision across the intercostal structures. This accomplishes the freeing of the tumor from all but its mediastinal attachments, but since the blood supply is derived from this side the operator often finds himself in a precarious position as the tumor itself interferes with the exposure and proper control of these vessels.

At this stage of the operation we have found it very convenient to place a braided silk snare about the mediastinal side of the tumor and to draw it tight. By this means, the mediastinal attachment of the tumor is reduced to a pedicle, its vessels are constricted, and the growth itself dislocated somewhat laterally. The tumor can then be removed with perfect hemostasis by incision of its capsule if benign, and enucleation of the mass lateral to the snare. After this maneuver the operator is left with a dry field in which the vessels to the tumor can be dealt with as necessary, and the serious and sometimes fatal hemorrhage which may result from tearing of the mediastinal structures can be avoided.

The technique is shown in Figure 1. Here the tumor has been approached through a paravertebral incision with resection of the posterior ends of the third to sixth ribs. The intercostal structures have been reflected laterally and the tumor exposed extrapleurally. The parietal pleura and



Fig.

underlying lung are being retracted and the snare is in place about the mediastinal aspect of the tumor. The next step is the proper right hand corner shows the pedicle after enucleation of the growth and ligation of the vessels and before removal of the snare.

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## TRENDS IN ANESTHESIA

**F**OLLOWING the discovery, approximately 100 years ago, of the value of ether and nitrous oxide as anesthetic agents, surgical procedures and methods were developed rapidly. After the original enthusiastic interest in ether and in chloroform had waned and routines for their administration by the open-drop method had been established, the medical profession allowed the practice of anesthesia to lag. Within recent years progress has been accelerated, and the evolution of new agents and methods for their administration has become so rapid that one is justified in saying that a revolution is in process of accomplishment. Several factors have contributed to this trend.

Patients are expecting and demanding more from the medical profession for the relief of pain. Physicians now have a wide choice of agents and methods, and an attempt to meet the demands of patients and of their surgeons is being made. It is no longer necessary for the patient to accept a fixed routine of anesthesia.

Agents and methods may be chosen to satisfy demands for adequate sedation and at the same time satisfactory anesthesia may be produced to facilitate the work of the surgeon.

To accomplish this, research has been stimulated and is being actively carried on in the fields of anatomy, pharmacology, physiology, physics, and chemistry. Many new agents have been developed, some have been investigated experimentally and a comparative few have had an adequate clinical trial. Older agents and methods of their administration too are being evaluated statistically in relation to the incidence of postoperative complications. A basis for comparison between the old and the new is being established.

This work has led to the realization that not only is the proper administration of anesthetic agents an art, but that the proper choice of agents and methods should be founded on a scientific basis. To establish criteria for proper selection of anesthetic agents, the collection of clinical and experimental data is continuing. To estimate the extent of interdependence between sets of phenomena, it is essential that negative as well as positive findings be known, a negative finding, not recorded, must be considered unknown. Complete clinical records, therefore, are of paramount importance if the data obtained are to be of any value. In a number of institutions data are being coded in a form suitable for recording on a punch card, to facilitate the sorting and computing of clinical data. As studies progress, opinions regarding certain factors representing cause and effect may be proved untenable, but it is hoped that scientific bases for the proper choice of anesthetic agents and methods of administration will be evolved.

Clinical experience experimental research, and statistical studies have revealed that certain agents and methods are worthy of inclusion in our accepted list. Methods have improved and their fields of application have been broadened. It is generally agreed that spinal anesthesia has merit for selected procedures, but as yet the agents and methods of application have not been standardized. The technique of carbon dioxide absorption introduced clinically by Waters, has been widely accepted as a distinct advance in the control of agents administered by inhalation. This development made possible the introduction of cyclopropane to clinical practice. Investigations are being undertaken by a number of groups and methods are being developed to minimize the hazards of inflammability from cyclopropane ethylene and nitrous oxide with ether added. It is confidently expected that the day is not too far distant when the danger of explosion will be greatly reduced. At the present time intravenous anesthesia can be offered as an alternative for certain procedures. Search continues for agents which will produce satisfactory relaxation of the abdominal musculature.

Anesthetists have broadened the field of their endeavor. In the diagnosis and treatment of intractable pain anesthesia plays its part, and in the diagnosis and prognosis of hypertension or of Raynaud's disease paravertebral injection of procaine is of value. Oxygen is administered under controlled conditions for the treatment of pneumonia, abdominal distention or cardiac decompensation. Mixtures of oxygen and helium are administered for the control of asthma. In some institutions recognition of the fact that the anesthetist is usually available at all times has resulted in the creation of an emergency service of which the anesthetist has charge. The administration of blood transfusions and of intravenous and oxygen therapy

has fallen within his domain. As a natural sequel in some institutions he has been made responsible for the manufacture of intravenous solutions. He therefore is completely responsible for them, and when untoward reactions occur as they infrequently do the cause may be traced and eliminated by him.

In the field of organization, significant progress has been made. The New York Society of Anesthetists was reorganized as the American Society of Anesthetists Inc. In 1938 the American Board of Anesthesiology Inc. an affiliate of the American Board of Surgery was formed and recently the Advisory Council for Medical Specialties, has recommended that independent status be granted.<sup>1</sup> Following the lead of California, Connecticut, and Indiana, a resolution has been adopted by the house of delegates of the New York State Medical Society granting a section on anesthesia in that organization. This action was followed by that of the American Medical Association in June 1940 granting a section in that organization.

Anesthetists in their development have gone through the stages of discovery experimentation, and clinical investigation. Many have developed manual dexterity. Medical regard and public prestige go hand in hand and anesthetists recognize this. Every attempt is being made to warrant the rank of consultant capable of cerebration rather than technician motivated by semiautomatic conditioned reflexes. To accelerate this trend medical schools throughout the country are urged to include the teaching of anesthesiology in their curricula with courses comparable to those for any other training they provide. Hospitals are gradually demanding higher standards of excellence for members of their staff practicing this specialty. Every effort is being made among the specialist

themselves to disseminate knowledge. Centers for postgraduate training have been established. Meetings are being held frequently throughout the country, travel groups have been formed, and finally a new journal *Anesthesiology*, the official publication of the American Society of Anesthetists was launched in July, 1940. Although the specialty is growing rapidly, it is still undermanned. Young physicians who are considering choice of a specialty, would be wise to enter the ranks of the anesthesiologists, provided they are convinced that the work would appeal to them.

RALPH M. TOVELI

## USE AND ABUSE OF TRACTION

THERE is probably no better method of treatment of inflamed joints, no matter what the cause, than traction applied in the right way and in the right amount. Nothing affords relief from pain in this condition, in my experience, so much as properly applied gravity extension. It is useful not only in treatment but in diagnosis. For instance, in a patient with excruciating pain in the region of the hip joint, it is difficult to determine whether the pain is the result of an infection of the hip joint or of an osteomyelitis of the upper end or the neck of the femur. If traction is applied under an opiate by means of a Buck's extension apparatus, and the patient sleeps comfortably without the use of opiates it is evident that an infected joint is present, but if the patient has no relief it is evident that an osteomyelitis is present.

The object of applying traction should be clear to the surgeon, the forceful traction necessary in the treatment of fractured bones and the extension applied for relief of joint pain are aimed at entirely different goals. The amount of traction necessary to reduce or hold a fracture in reduction and the amount of traction necessary to relieve pain in an in-

flamed joint are entirely different things. In the former condition, our effort is to overcome the pull of muscles which have a tendency to displace the fracture, in the latter, the object should be to relieve muscle spasm caused by irritation of the reflex arc from the joint to the muscles controlling that joint, to take pressure off the inflamed joint surfaces and to put the joint at rest.

The improper use of traction may result in overextension in the wrong direction. Traction should never be used for too long a period or in such a manner that the tissues or nerves are injured. Nerve injury might lead to complete paralysis. In the case of a fracture of the surgical neck of the humerus, for instance, if traction is applied with the arm at a 45 degree angle midway between abduction and adduction, with the elbow slightly forward of the midline or at a level with the anterior plane of the body and the elbow flexed and suspended, the brachial plexus will not be injured. The capsule of the joint probably may be overstretched, but the capsule will usually make some recovery after such overstretching.

In an injury to the cervical spine with fracture but without dislocation, the result of indirect violence to the joints of the neck, it is not unreasonable to assume, that, in view of the construction of the cervical spine, severe traction applied for a long period and pulling on the joint capsule, the ligaments, and muscles of the neck, will damage these structures as much as the original injury had damaged the joints.

Traction is applied to inflamed or damaged joints to relieve the pressure on the joint surface, not to replace any displaced fragments. Overexertion of force on the ligaments and capsule surrounding the joint will produce overstrain and injury in direct proportion to the amount of overweight applied. These

tissues are quite elastic but no tissue in the body will stand overstrain for a considerable period of time without pain, and a traumatic inflammation can be produced by overtraction treatment as easily as by injury from any other cause.

Traction of the right amount properly applied gives more relief in sacro-iliac and lumbosacral arthritis, regardless of the cause than any other procedure with which I am familiar. Occasionally it takes from 24 to 72 hours to secure complete relaxation of the tissues, but when relaxation takes place the pain is relieved although it may recur immediately when weight bearing is resumed unless the inflammation which caused the pain has subsided. If too much weight is applied the ligaments supporting the joints are stretched, the muscles go into spasm instead of being relieved from spasm, and the patient automatically fights the traction. Eight pounds seems to be the amount advisable to be applied to the leg in the form of Buck's extension. For a patient with comparatively weak muscular and ligamentous structure six pounds is often sufficient. In cervical arthritis, especially of traumatic origin four pounds is the maximum to be applied.

Traction should always be made in a direct line with the long axis of the bone or bones and joints being treated. If the pulley over which the traction rope runs is too high or too low in its relation to the bed, an angulation occurs. This in itself throws abnormal strain

on the joint involved or the joints above or below it. Care should be taken that the right amount of traction is applied and that the pull is at the correct angle. Traction for inflamed joints should give these joints relief. If there is not sufficient pull in the proper line or if the traction is too great, there will be no relief of pain. The object of this treatment is balance of muscles for the relief of muscle spasm, with a mild separation of joint surfaces without trauma to the supporting capsule and ligaments of the joint.

When traction is used for a fracture counterbalancing of the pull of the muscles is the objective. The amount of traction frequently must be greater but it is usually applied in a different way and certainly for a distinctly different purpose. Again it should be stated that the purpose of the traction should be clearly in mind when it is applied.

At all times the traction must be maintained free of any obstruction and in correct alignment. This means at least daily observation. The one responsible for treatment in the surgeon's absence should be cautioned that the weights must not be changed under any circumstances without permission.

A constant smooth pull of gravity may be used for the relief of pain in almost any joint inflammation and, in my opinion when properly used is one of the most valuable adjuncts in the treatment of joint inflammation and prevention of deformity.

PAUL B. MAGNUSON

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

THE book entitled *Atlas of Surgical Operations* by Cutler and Zollinger<sup>1</sup> is dedicated to and prepared especially for the instruction of the young surgeon in his period of training during his interne and resident years. It is true that textbooks of surgery for the medical student can no longer deal with technique, limited as they must be to a consideration of diseases treated by surgical measures and to the fundamentals of the principles of surgical art and science. It is also true that anyone wishing to learn details of operative technique must consult many works, which often confuse by presenting many methods of attaining the same end. This atlas is designed to present in a single volume the common operations of general surgery and gynecological surgery with sufficient detail so that the technical steps of these procedures will be clear to the neophyte operator.

The book opens with 3 short chapters on surgical technique, anesthesia, and pre-operative and post-operative care. They are philosophical in approach and necessarily, because of their brevity, make no effort to cover these basic considerations with any completeness. The remainder of the work presents operations that have become more or less standardized in modern surgical practice.

True to title, the subject is illustrated by plates, 84 in number, of large size, on which are shown with pen and ink drawings the steps in the operations. The illustrations are by Miss Mildred Coddington and in the main she has depicted clearly the minutiae of the steps in these operative procedures. The illustrations are accurate and usually entirely adequate, but are somewhat colorless, if the term can be applied to black and white, and would gain in attraction and brilliance, if not in usefulness, if the illustrations were made with more contrast. The plates suggest somewhat operations carried out on the cadaver, since in life, tissues abound with contrast and vitality. On the page opposite each plate, instruction is given succinctly without qualification, on the indications, pre-operative preparations, anesthesia, position, operative preparation, incision and exposure, details of operative procedure, closure, and postoperative care, so that easy reference is made from plate to written description.

The authors state that the technique described "emanates from the school of surgery inspired by William Stewart Halsted." The goal is admirable, but Halsted's contributions, great as they were, cannot be demonstrated in an atlas since they consisted of a mode of action and thought rather than

an insistence upon anatomical operative details alone. To be consistent in spreading Halsted's gospels in static form, one might well illustrate with Halstedean exactness operative techniques developed by him such as thyroidectomy, radical mastectomy, and herniorrhaphy.

By and large, the operative procedures are described and illustrated so as to be instructive and helpful, and one may state it as a truism that the nearer the surface of the body, the more accurately can the technique be depicted and more precisely carried out by the ready study of diagrams. Some operations, such as the *abdominoperineal resection* of the rectum, cannot be learned from cuts alone, since drawings and the written word cannot truly give an idea of what the hand feels and does.

The large plates made obligatory a large volume and unfortunately the folio size of the book makes it a mechanical nuisance in any modern library, even though it follows the respectable example of antique surgical literature. It is to be hoped that in the other editions—and it is certain that they will be forthcoming—a more easily handled format will be considered.

Experienced surgeons will undoubtedly differ from the authors on many points and these surgeons will also disagree with one another, but I think all surgeons will agree that the technique shown in the atlas is a safe one and they will feel that the authors are to be congratulated upon striking a usable mean in their selection of methods. One might be critical of illustrating only open types of intestinal anastomoses since there are now in common use several satisfactory methods of making closed union, one of which at least should have been shown to emphasize the importance and availability of the aseptic method. The young surgeon will be on solid ground in following the methods shown until his own experience dictates changes.

Since the work is after all a skeleton, it is to be hoped that it will be used only by those young surgeons whose training gives them succulent tissue of physiology, chemistry, and pathology to cover the dry bones thus presented. For those whose training does not offer this scientific padding, one can only hope that they will realize that pictures do not bleed and that large folio volumes do not die of pneumonia, of embolism, and of shock.

The authors and the illustrator are to be congratulated upon presenting a volume that will be of tremendous value to the young surgeon in the midst of a sound training and to all of these, the book is heartily recommended. It has a place on the table of every hospital library where young men are

<sup>1</sup>ATLAS OF SURGICAL OPERATIONS. By Elliott C. Cutler and Robert Zollinger. New York: The Macmillan Co. 1933.

learning the arts of surgery

FREDERICK A. COLLIER.

THE condensed encyclopedia, *Modern Medical Therapeutics General Practice*, edited by Barr<sup>2</sup> will be useful to have at hand in everyday practice. It consists of three volumes of 200 pages each, light in weight for their size and conveniently indexed. The articles are brief and are written by authorities who have firsthand knowledge of the subject and who, usually, have contributed original research to the field they are discussing. In addition to therapy of all medical diseases that of genito-urinary, gynecological, neurological, ear, nose and eye specialities, is also included. General procedures such as psychotherapy, physiotherapy and dietotherapy among many others, are thoroughly presented, occupying more than half of volume I. In general, the work can be heartily recommended both for its completeness and for its reliability. P. W. STARR.

THERE is growing impression among the leaders of the medical profession that malignant disease is not given the consideration it deserves. Those who see many cases in both clinic and private practice observe far too many instances of careless or ill directed medical attention. The American Society for the Control of Cancer is successfully promoting a program of lay education that has a reaching effect. However much of its benefits are nullified by the lack of the proper conception of malignant disease by a large percentage of the medical profession. It is continuously stressed that the crux of the cancer problem is very early diagnosis and immediate, adequate and approved treatment; therefore unless the entire medical profession becomes alert to the problem lay education will be of little benefit and the morbidity and mortality of the disease will continue to mount.

More and more the problem of diagnosis and treatment of malignant disease is developing into a speciality. Diagnostic procedures such as the proper evaluation of the clinical history and physical findings, the biopsy, the correct interpretation of x-ray films, and the precise decision on the form of therapy are problems that can be answered to the best interest of the individual patient only by one well trained in this field. The problem of therapy deserves concrete consideration. Too frequently the surgeon advises operative therapy not because this form of treatment is best suited to the case in question but because it represents his one and formidable type of treatment. On the other hand the radiologist may advise irradiation either by radium or x-ray on the same basis because he has the facilities for such therapy and it is his means of livelihood and, perhaps, of assisting him in paying for expensive equipment. It is obvious that such trends cannot and do not answer the problem of cancer therapy.

With this perplexing problem acutely in mind it was great joy to review the recent new work by Pack and Livingston. In this extensive treatise is concentrated the largest amount of concrete and practical information on the subject of cancer therapy that is known to the reviewer. An adequate or first review is impossible in the comparatively limited space allocated for the purpose. This treatise consists of three volumes totaling 1,500 pages prepared by 147 authorities of national and international reputation in their respective fields of cancer diagnosis and therapy under the editorship of two eminently qualified men. The work is illuminated by 300 illustrations. Every phase of the problem of cancer therapy is discussed in detail and with such clarity and precision that little if anything is left to the imagination of the reader.

In volume I one of the outstanding sections is that devoted to general principles of treatment. Here are discussed such subjects as the prevention of cancer, the organization of tumor clinics, microscopic grading, the surgical, pouch and aspiration biopsy, the principles of radiation therapy and a chapter on radio-sensitivity of tumors by Stewart and Farrow that is classic. This section comprises 273 pages prepared by 8 contributors including such eminent authorities as E. J. G. Greenough, Broders, Stewart, Quimby, Pack, Livingston, Chason, and others. Volume I also contains descriptions of the treatment of cancer of the mouth and pharynx, larynx, neck, thyroid and parathyroids, breast, and the chest. All of the material is in excellent form and treats a pertinent information such topics as the treatment of carcinoma of the lip, radiation treatment of cancer of the buccal mucosa, radiation therapy of cancer of the tongue and the treatment of carcinoma of the floor of the mouth are milestones in surgical literature. A most logical and lucid description by Duffy of the indications for neck dissection and for irradiation of cervical nodes in intracranial carcinoma, is ample reason for possessing the treatise. The editors' introduction to the treatment of cancer of the breast is truly conspicuous contribution.

In volume II are considered the esophagus, stomach, the intestinal tract, colon, rectum, and the female genitalia. The thoroughness with which the subjects are presented can be illustrated by survey of the section on the treatment of cancer of the rectum. Such eminent authorities as Jones, Rankin, Lahey and C. Tell, Babcock, Spangler, Burch, and Yeomans are contributors. Binkley and Shelden present the subject of radiation therapy.

Volume III is devoted to the urinary system, male genitalia, the skin, eye and orbit, the nervous system, bone and synovial membranes, the lymphoid system, and miscellaneous, the latter including electro-surgical treatment, control of hemorrhage, rectal anastomosis, fever therapy, colostomy and thyroid and

the care of patients in the incurable and terminal stages of cancer. Throughout this volume the same thoroughness and clarity prevail. Subjects so important in correct evaluation as to treatment of cancer of the penis and bladder, kidney tumors, lesions of the skin, and the like, are so clearly classified and the treatment so specifically described that nothing is left for the reader to question.

In résumé it must be conceded that the final word on cancer therapy has not been spoken, however, the advancements made in the past decade are significant, even more, they are auspicious. The recognition of such a fact as cited by Martin relative to cancer of the lip (vol. I, p. 325) that "Early cases with lesions up to 1.5 cm in diameter should be cured in practically 100 per cent of instances if the patient is regularly observed and examined for recurrences" is, indeed, encouraging and should initiate a profound optimism and stimulate every physician to apply himself to the task of early recognition of the disease and the application of the proper type of therapy for the cancerous lesion.

It is the conviction of the reviewer that this treatise will do more to enlighten the medical profession on the cancer problem, specifically cancer therapy, than any other single effort. No one can read this work without obtaining a boundless enthusiasm intimately interwoven with lucid and concise information. It clearly points the way of cancer therapy into surgical or radiological channels or a manifest combination of the two and establishes the fact that adequate diagnostic and therapeutic procedures for cancer can be conducted only by a harmonious and intelligent co-operation of the pathologist, the radiologist, and the surgeon. This treatise will become the Mecca for the cancer therapist who really desires to give his patients the best type of treatment.

JOHN A. WOLFER

THE two volume text, *Specialties in Medical Practice*,<sup>1</sup> edited by Dr. E. V. Allen of the division of medicine of the Mayo Clinic is published in loose leaf form by Thomas Nelson and Sons. It is closely patterned after the style of Nelson's *Medicine and Surgery* and is apparently designed to compensate for the special medicine and surgical fields that are not already covered in their regular volumes. Outside of the comparatively new fields of vitamins, endocrinology, and perhaps allergy, these various sections do not present anything particularly new in these specialties but rather offer in a brief form the fundamentals of diagnosis and treatment of the most commonly seen disorders in these special fields. Most of these sections are profusely illustrated with both black and white and colored prints. Some of the sections are summarized in chart form at the end of the discussion.

This text contains sections on ophthalmology, otolaryngology, neurology, psychiatry, vitamins and

vitamin deficiency diseases, allergy, orthopedic surgery, endocrinology, urology, proctology, dermatology, and syphilology. The latter, being written by Dr. Svend Lomholt of Copenhagen, Denmark, is still in preparation. These chapters are not arranged in any particular order in these volumes and seem to be rather haphazardly compiled. Chapters are written by men well known in their particular fields of medical and surgical practice. Louis A. Buie, psychology, and John L. Emmett, urology, are the only other contributors to the volume from the Mayo Clinic.

Dr. Allen has attempted to present through these men only the most fundamental and practical points regarding their specialties. Rare diseases, etiology, pathology, and descriptions of difficult operative techniques have not been emphasized. Because this book has been designed mainly for the general practitioner so that he can receive practical and useful information that will aid him in his practice, emphasis has been placed on symptoms, diagnosis, and treatment of the most common disorders in these various fields. The style and method of these presentations are, of course, as varied as the number of contributors. Sections on ophthalmology, otolaryngology, endocrinology, vitamin diseases, and urology are particularly well written from the standpoint of simplicity in presentation, usefulness, and therapeutic technique. Other sections, such as those on obstetrics and gynecology, are presented in the style and detail of a regular textbook and seem to be out of place in this type of volume.

The sections on neurology, psychiatry, and orthopedic surgery are too brief and sketchy. It is realized that the scope of these specialties is extremely broad, and one wonders whether or not they lend themselves to contraction. In an attempt to cover the whole field of the specialties in a relatively small section, practical diagnostic points and therapeutic measures that might be used by the general practitioner have not been presented in an adequate manner.

On the whole these volumes are a good supplement to the already established sets of Nelson's *Loose Leaf Medicine and Surgery*. They should be of interest to the busy general practitioner who finds textbooks on these subjects written in a style that is too complicated and in too much detail. It may be of value to the specialist who would like to acquire a speaking acquaintance with the progress that has been made in other fields of medical practice while he has been concentrating in his own special field. It is not a good text for the medical student as it does not give the underlying pathology, basic facts, and reasons for procedure. There is too much superstructure and not enough foundation.

Dr. Allen has done well with the material from many diversified fields in bringing them together in one text, so as to make it possible for the busy general practitioner or specialist to digest these various subjects in small doses at bedtime.

H. A. LINDBERG

<sup>1</sup>SPECIALTIES IN MEDICAL PRACTICE. Edited by Edgar Van Nuys Allen, M. D. With a Foreword by Donald C. Balfour, M. D. New York and Edinburgh: Thomas Nelson & Sons, 1940.



THE past two or three years have seen the appearance of several books dealing with the subject of cranio-cerebral injuries—indeed a major twentieth century problem—and all those which have been read by this reviewer agree in general in their explanation of the pathology incident to such injury and the proper treatment of the immediate injury. Gross and Ehrlich<sup>1</sup> agree with the presently prevailing thought that the term "concussion" is a poor one and that the actual changes in the tissues during such state are unknown, yet they likewise fail to supply a term which is satisfactory for this very definite clinical posttraumatic syndrome.

Their diagnostic approach is direct and simple, taking advantage of modern methods but being careful not to overmanipulate the patient. They believe that no rigid plan of treatment can be followed, since the condition of patients with cranio-cerebral injuries varies widely from individual to individual. They

<sup>1</sup>DISCUSSION ON TREATMENT OF HEAD INJURIES. By Henry W. Gross, M.D., F.A.C.S., and William Ehrlich, M.D. *Instructions for Postural Rest*. M.D. Ph.D. New York and London: Paul B. Hoeber, Inc. 1929.

stress the need of attention to simple but important matters such as the care of bowels, bladder and skin, the adequate nourishment of the patient, and above all sufficient rest for the patient. They do not advocate routine lumbar puncture.

A good deal of space is given over to the matter of operative technique, a subject which could have been omitted to allow broader treatment of post-traumatic convulsive states, psychotic manifestations, and other complications of head injuries, since most surgeons have their own favorite techniques of operation in such cases. It is interesting to note that they drain the operative wound after the removal of an extradural clot, but they do not drain the wound after, for example, the repair of gun-shot wound of the scalp, skull, and brain.

The book is short and therefore some of the subjects are necessarily treated in "telescopic" manner. Chapter VII, on the subject of gunshot wounds, is full of practical information, and it seems particularly timely in this present period of world-wide military strife. There is appended a good bibliography.

JOHN MARTIN

## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

THE ROCKEFELLER FOUNDATION, ANNUAL REPORT. 930. New York, 940.

PROBLEMS OF NERVOUS ANATOMY. By J. Boeke, M.D. (Glasg.) London: Oxford University Press, 940.

OFFICE CLINICAL CHEMISTRY. LABORATORY GUIDE FOR THE PRACTITIONER AND HOSPITAL. By Frederick M. Abernethy, B.S. Ch.E., M.A., Ph.D., M.D. London, New York, Toronto: Oxford University Press, 940.

EXPECTANT MOTHERHOOD. By Nicholson J. Eastman, M.D. Boston: Little, Brown & Co., 940.

HANDBOOK OF SKIN DISEASES. By Leon Hark Warren, B.A., M.D. M.Sc. (Med.) With foreword by F. D. Weidman, M.D. New York, London: Paul B. Hoeber, Inc., 940.

THE ANATOMY OF THE FEMALE PELVIS. By F. L. Maguire, C.M.G., D.S.O., M.D. M.D. Ch.M. F.R.C.S. (Eng.) FRACCS. F.R.C.O.G. 3d ed. Sydney: London: Angus & Robertson, 940.

HICOK YOUNG A. SEAFORTH'S AUTOBIOGRAPHY. New York: Harcourt, Brace & Co., 940.

CARLOS FREYLA AND YELLOU PETER. By Carlos F. Freyly, M.D. F.A.C.S. Edited by Morton C. Kahn, M.A., Ph.D. Sc.D. Published under the auspices of The Institute of Tropical Medicine of the University of the Azores. New York: Oxford University Press, 940.

CHAMBERLAIN'S TECHNICAL DICTIONARY. Edited by C. F. T. Every and L. E. C. Hughes. A.C.C.I. D.I.C., B.Sc., Ph.D. ADRIAN ADRIAN M.A.S.L. New York: The Macmillan Co., 940.

A TEXTBOOK OF SCROFULA. By Henry S. Brookes, J. M.D. and Pearl Castle, R.D. A.B. M.A. 2d ed. St. Louis: The C.V. Mosby Co., 940.

MANAGEMENT OF THE CARBUNCLE TIT. By William O. Leaman, J. M.D. F.A.C.P. Philadelphia, London, and Montreal: J.B. Lippincott Co., 940.

NEW AND UNOFFICIAL REMEDIES, 940. Containing Descriptions of the Articles Which (and Accepted by the Council on Pharmacy and Chemistry of the American Medical Association on January 940. Chicago: American Medical Ass., 940.

ANNUAL REPORT OF THE REPORTS OF PEARCE TO CHEMISTRY OF THE AMERICAN MEDICAL ASSOCIATION FOR 1939 WITH THE COMMENTS THEREON. IT IS APPEARED IN THE JOURNAL. Chicago: American Medical Ass., 940.

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

GEORGE P MULLER, Philadelphia, *President*  
EVARTS A GRAHAM, St Louis, *President-Elect*

*Committee on Arrangements*

JOHN A WOLFER, *Chairman*, CHARLES B PUESTOW, *Secretary*

## PROGRAM FOR THE CHICAGO CLINICAL CONGRESS

THE 1940 Clinical Congress of the American College of Surgeons will be held in Chicago, October 21-25. This will be the thirtieth assembly of this great organization of surgeons of the United States, Canada, and Latin America, the first of these meetings having been held in Chicago in 1910. The surgeons of this city are privileged to be hosts to this meeting for the eighth time since the Clinical Congress of Surgeons of North America initiated this vast educational program which places the primary emphasis upon well organized clinics conducted in the hospitals of a great medical center. Under the leadership of a strong and representative committee of Chicago surgeons, the clinical program to be presented by the five medical schools and forty approved hospitals will constitute a highly organized postgraduate experience for all those attending the meeting. Representing as it does the interests of all surgical specialists as well as general surgeons, this Congress will provide a complete and varied program during the five days of the meeting.

### CLINICAL PROGRAM

The major feature of the Clinical Congress, as arranged by the local committee, will be an extensive schedule of operative and non-operative clinics, demonstrations, symposia, and exhibits conducted by over six hundred Chicago surgeons. These presentations will cover all phases of the clinical activities in the surgical and other departments of the hospitals and medical schools. The latest advances in diagnostic methods, surgical techniques and operative procedures will be demonstrated. Many of the clinics will deal with pertinent subjects related to pre- and postoperative care of the surgical patient. The program of each operative clinic has been planned with the idea of presenting related problems in diagnosis

and other special aspects of the management of the surgical condition under consideration. In so far as possible the end results which have been obtained following the specific surgical treatment will be demonstrated.

Non-operative clinics, demonstrations, symposia and exhibits have been planned to cover various special features of the work which is being done in many of the hospitals and medical schools. Again all of the special fields of surgery will be represented in this phase of the clinical program, affording visiting surgeons the opportunity to study at first hand the latest advances in clinical surgery as well as important experimental and research activities of the Chicago institutions.

The program of each institution is being arranged to cover subjects in general surgery, fractures and other traumas, neurosurgery, orthopedic surgery, thoracic surgery, urology, obstetrics and gynecology, ophthalmology, and otorhinolaryngology. The clinical program, organized under this classification, is being so correlated that those attending the Congress will have ample opportunity to devote their time continuously to clinics dealing with subjects related to the specialty in which they are most interested. Clinics and demonstrations will be held on the afternoon of Monday, October 21, and the mornings and afternoons of each of the four succeeding days.

In order to aid the visiting surgeons in selecting the clinics which they desire to attend, the complete details of the clinical program for the following day, arranged according to the foregoing classification of subjects, will be posted each afternoon in the form of bulletins at headquarters in the Stevens Hotel, permitting the advance requisition of clinic tickets. The *Daily Clinical Bulletin* giving this detailed program in printed form will be distributed each following morning during the Congress.

## CLINICAL CONGRESS PROGRAM IN BRIEF

(All sessions at the Stevens Hotel except as noted)

*Monday, October 2*

- 10:00 Hospital Conference
- 1:30 Panel Discussions (5)
- 1:00 Clinics in Chicago hospitals
- 1:00 Hospital Conference
- 1:00 Surgical Film Exhibition, General Surgery
- 3:00 Assembly of Initiates, followed by reception—  
Headquarters of College
- 7:30 Panel Discussions (5)
- 8:00 Presidential Meeting and Convocation.

*Tuesday, October 3*

- 7:45 Breakfast Conference
- 9:00 Clinics in Chicago hospitals
- 9:30 Hospital Conference
- 9:30 Surgical Film Exhibition, Eye, Ear, Nose and  
Throat Surgery
- 1:00 Surgical Film Exhibition, General Surgery
- 1:00 Group Conferences, Eye, Ear, Nose and Throat  
Surgery ( )
- 3:00 Panel Discussions (5)
- 3:00 Clinics in Chicago hospitals
- 3:00 Hospital Conference
- 3:00 Symposium on Fractures and Other Traumas
- 3:00 Surgical Film Exhibition, General Surgery
- 5:30 Panel Discussions (4)
- 7:00 Surgical Film Exhibition, Eye, Ear, Nose and  
Throat Surgery
- 7:30 Hospital Conference
- 8:00 Scientific Session, General Surgery
- 8:00 Scientific Session, Ophthalmology
- 8:00 Scientific Session, Otorhinolaryngology

*Wednesday, October 3*

- 7:45 Breakfast Conference
- 9:00 Clinics in Chicago hospitals
- 9:30 Hospital Conference
- 9:30 Surgical Film Exhibition, Eye, Ear, Nose and  
Throat Surgery
- 9:30 State and Provincial Judiciary Committees
- 1:00 State and Provincial Executive Committees
- 3:30 State and Provincial Credentials Committees and  
Committees on Applicants

- 1:00 Group Conferences, Eye, Ear, Nose and Throat  
Surgery ( )
- 1:00 Meeting of Board of Governors
- 3:00 Panel Discussions (5)
- 3:00 Clinics in Chicago hospitals
- 3:00 Symposium on Cancer
- 3:00 Surgical Film Exhibition, General Surgery
- 3:30 Hospital Conference
- 5:30 Panel Discussions (5)
- 7:00 Surgical Film Exhibition, Eye, Ear, Nose and  
Throat Surgery
- 7:30 Hospital Conference
- 8:00 Scientific Session, General Surgery
- 8:00 Joint Session, Sections on Ophthalmology and  
Otolaryngology

*Thursday, October 4*

- 7:45 Breakfast Conference
- 9:00 Clinics in Chicago hospitals
- 9:30 Hospital Conference
- 9:30 Surgical Film Exhibition, Eye, Ear, Nose and  
Throat Surgery
- 1:00 Surgical Film Exhibition, General Surgery
- 1:00 Group Conferences, Eye, Ear, Nose and Throat  
Surgery ( )
- 3:00 Annual Meeting, Fellows of the College
- 3:00 Clinics in Chicago hospitals
- 3:00 Hospital Conference
- 3:00 Panel Discussion—Graduate Training in Surgery
- 5:30 Panel Discussions (5)
- 5:30 Surgical Film Exhibition, General Surgery
- 5:30 National and Regional Fracture Committees
- 7:00 Surgical Film Exhibition, Eye, Ear, Nose and  
Throat Surgery
- 8:00 Scientific Session, General Surgery
- 8:00 Scientific Session, Ophthalmology
- 8:00 Scientific Session, Otorhinolaryngology

*Friday, October 5*

- 9:00 Clinics in Chicago hospitals
- 9:30 Surgical Film Exhibition, Eye, Ear, Nose and  
Throat Surgery
- 1:00 Surgical Film Exhibition, General Surgery
- 1:00 Clinics in Chicago hospitals
- 1:00 Group Clinical Conferences (7)
- 1:00 Surgical Film Exhibition, General Surgery

## EVENING SCIENTIFIC SESSIONS

The opening scientific session of the Clinical Congress will be held on Monday evening in the Ballroom of the Stevens Hotel, when the Presidential Meeting and Convocation will be combined. The new officers of the College will be inaugurated and the 1940 class of initiates received into fellowship. Distinguished surgeons from foreign countries will then be introduced, following which Dr. George P. Muller of Philadelphia, will deliver the presidential address taking for his subject

The College and American Surgery. Principles of Colonic Surgery will be the subject of the sixth annual oration on surgery to be delivered by Dr. Fred W. Rankin, Lexington, Kentucky.

Scientific meetings will be held on Tuesday, Wednesday and Thursday evenings at the headquarters hotel, when distinguished members of the profession of international prominence will address the assembled guests of the Congress. Complete programs for all sessions will be found in the following pages. The speakers and subjects of these addresses have been carefully selected in order to assure presentations which will be of interest to those who are practicing in all of the special fields of surgery. These programs have been prepared under the direction of the Board of Regents of the College to give consideration to as many of the latest advances in general surgery and the surgical specialties as possible.

## PANEL DISCUSSIONS

Panel discussions have met with such decided success at the Clinical Congress and in the sectional meetings of the College that the schedule this year will include an elaboration of this phase of the program as it is arranged for Monday, Tuesday, Wednesday, and Thursday afternoons. Recognized authorities in special fields are co-operating with the College as leaders and collaborators of these panels, and the 34 topics which have been selected cover many pertinent subjects. This type of program permits more informal discussion of the subject than would be possible in the larger meetings. The plan provides that the leader will present his subject within a ten minute period, collaborators will then discuss various phases briefly, after which general discussion from the floor will be encouraged. These sessions have given unusual opportunities to a large group of surgeons to present their viewpoints on various subjects at the *Clinical Congress* and in the sectional meetings during recent years, and have proven to be exceedingly popular. Therefore it will be necessary to limit the attendance to those who can be comfortably seated in the conference rooms. Tickets will be available each morning at the registration desk for the panels scheduled for that day.

## GROUP CLINICAL CONFERENCES

A new feature of considerable interest to all surgeons attending the Congress will be the series of group clinical conferences which is being arranged for Friday afternoon. Seven special fields of surgery have been selected and an important subject of current interest will be briefly presented in each conference. These special fields are Fractures and other traumas, neurosurgery, obstetrics and gynecology, orthopedic surgery, plastic surgery, thoracic surgery, and urology. The leaders are selecting the subjects which will be presented. They will direct discussions from the floor and visitors attending the meeting will be invited to present any problem with which they may be concerned—one that is related to the special field under discussion. Recognized authorities will endeavor to answer these questions and offer as much helpful advice as possible. Everyone should benefit by participating in consultation conferences of this nature.

## SYMPOSIUM ON CANCER

The Cancer Committee of the College has done outstanding work in furthering the development of cancer clinics in hospitals and providing for the registration of cured cases of malignant disease in

the cancer archives. The chairman of this committee will give a brief review of these activities of the College in opening the symposium on cancer which will be held Wednesday afternoon. Other subjects of practical interest which will be presented include various problems in the diagnosis and treatment of "Neurogenic Sarcoma" and "Pelvic Cancer." In addition, one speaker will discuss "The Present Status of Carcinogens and Hormones in Cancer Research" and another will lead a discussion on the subject of "Radiation Damage of Tissue and Its Repair." In this symposium the surgeon, the pathologist and the radiologist will discuss important aspects of the cancer problem which are of current interest.

## SYMPOSIUM ON FRACTURES AND OTHER TRAUMAS

In this symposium, to be held on Tuesday afternoon, the Chairman of the committee will make a brief statement concerning the work which has been done during the past year by the national and regional fracture committees. The scientific papers to be presented at this meeting will emphasize practical subjects dealing with different types of fractures which present special problems in management and treatment. One of the papers will deal particularly with "Undergraduate Education in Fractures and Other Traumas." The program will be of interest to all surgeons who engage in this type of practice and will afford an opportunity for them to learn different viewpoints regarding the handling of many clinical problems.

## OPHTHALMOLOGY AND OTOLARYNGOLOGY

A new departure from the proceedings of the Congress in former years is being arranged in ophthalmology and otolaryngology. Separate sessions scheduled for Tuesday and Thursday evenings will include panel discussions and symposia on important subjects in these fields. The leaders and a group of outstanding surgeons will direct the discussions in these meetings so as to cover many phases of a general subject in each of the specialties and a number of different viewpoints will be expressed. On Wednesday evening, there will be a joint session of ophthalmologists and otolaryngologists with a symposium on the important subject "Primary Treatment of Injuries about the Face." An ophthalmologist, an otolaryngologist, a maxillofacial surgeon, and a neurosurgeon will cover all aspects of this subject. This type of program promises to attract wider interest than the usual presentation of formal papers.

Clinics in Chicago hospitals each morning and afternoon for the visiting ophthalmologists and otolaryngologists will demonstrate surgical work

of a wide variety. On Tuesday, Wednesday and Thursday mornings, in addition to the hospital program, there will be clinical conferences for each group of specialists at the headquarters hotel. These have been arranged so that the leader will briefly survey the field for discussion in a ten minute period. The session will then be broken up into small groups limited to twenty each with a separate leader where there will be an opportunity for everyone to ask questions and participate in the discussions. Each surgeon may select in advance the small section of the meeting which he wishes to attend. Through this plan the general subject will be discussed thoroughly and everyone will profit by the experience and different viewpoints of his colleagues which will be presented. The success of these conferences is assured. The morning and evening meetings will be preceded by the showing of selected motion picture films dealing with ophthalmology and otolaryngology.

#### ANNUAL MEETING OF THE FELLOWS

The annual meeting of the fellows will be held on Thursday afternoon in the ballroom of the Stevens Hotel beginning at 1:30. The American College of Surgeons has been a potent force which has not only materially raised the professional and ethical standards of surgery but has also promoted good hospitalization and general improvement in the practice of medicine in the United States and Canada. These activities have received wide recognition by professional groups and the public as well. Each individual fellow of the College has a part in this work and may extend its influence materially in his local community. Hospital standardization alone offers him unlimited opportunity to provide better medical care for his patients in the hospital in which he works through continuous progress in applying the principles of the minimum standard.

The annual meeting of the fellows affords the officers of the College an opportunity to report on the activities of the organization and to receive suggestions from those who have made possible this vast educational program. Reports will be presented of the work which is being done in hospital standardization, graduate training in surgery, cancer clinics, medical service in industry, the Clinical Congress and sectional meetings of the College, also reports of the committees on fractures and other traumas, bone sarcomas, the library and department of literary research, the hall of the art and science of surgery and medical motion pictures. The finance committee report will also be presented and the work of the State

and Provincial judiciary, credentials, applicants and executive committees will be reviewed. These reports, which are given to the fellows of the American College of Surgeons, will clearly indicate what this great organization is accomplishing. Every fellow attending the Congress will want to be present at this important meeting.

#### GRADUATE TRAINING IN SURGERY

Following the annual meeting of the fellows on Thursday afternoon an open forum on graduate training in surgery will be held, with informal discussions from the floor under leadership which should stimulate comments by widely recognized teachers of surgery who will be present. The report of the Committee on Graduate Training in Surgery which is representative of general surgery as well as the surgical specialties will be given by its Chairman. This report summarizes the program which has been recently undertaken by the College and brings up to date statistical information on approved plans of graduate training in surgery in approximately two hundred hospitals of the United States and Canada.

There will be one formal paper at this meeting which presents the role which the hospital without direct medical school connections may play in developing an adequate educational program in surgery. The plan of teaching which can be developed in this type of institution will be discussed in detail. The remainder of the time will be given over to informal discussions from the floor and the entire program should elicit the interest of all surgeons, hospital executives and educators who are concerned with the future standards of surgery.

#### ANNUAL MEETINGS OF COMMITTEES

The annual meetings of the State and Provincial Judiciary, Credentials, and Executive Committees will be held on Wednesday morning. These committees have an important function to perform in the activities of the College. The Credentials Committees and the Committees on Applicants provide an organization which constitutes one of the largest and most carefully deliberate accrediting bodies which exist in the medical profession. Through this organization, the standards of fellowship are maintained and each fellow of the College has a definite responsibility in this work. All members of each of these committees are urged to attend these important sessions.

#### MEETING OF NATIONAL AND REGIONAL FRACTURE COMMITTEES

The meeting of the National and Regional Fracture Committees will be held on Thursday

afternoon, when this large body of surgeons will assemble for a discussion of the activities of the respective groups. Working in co-operation with the American Red Cross, other local organizations and public officials, these committees have exerted great influence in providing improved methods and facilities for the transportation of the injured. There has also been a concerted effort to improve the treatment of fractures in the hospitals of all communities.

#### ASSEMBLY OF INITIATES

On Monday afternoon in the Auditorium of the American College of Surgeons headquarters at 40 East Erie Street, there will be held the Assembly of Initiates. This meeting will be presided over by Dr. George P. Muller, President of the College, and Dr. Arthur W. Allen, Boston, Vice-Chairman of the Board of Regents. Dr. Bowman C. Crowell and Dr. Malcolm T. MacEachern will discuss "The Program of the American College of Surgeons." Initiates will then recite the Fellowship Pledge and greetings will be extended by Dr. Everts A. Graham, St. Louis, President-Elect of the College. Closing remarks will be made by Dr. Irvin Abell, Chairman of the Board of Regents. Following the adjournment of this assembly, a reception for the initiates, their wives, friends and fellows will be held by the officers and Regents of the College.

#### HOSPITAL CONFERENCES

The twenty-third annual hospital standardization conference will open the Clinical Congress with a meeting at the headquarters hotel on Monday morning at 10 00 o'clock. The report of the 1940 hospital standardization survey—official announcement of the list of approved hospitals and hospitals approved for graduate training in surgery—will be made at this session. In addition, there will be a very interesting discussion on "Medical Preparedness in the Case of a War Emergency." The Surgeon General of the United States Navy, Rear Admiral Ross T. McIntire, will give a brief address and E. W. Jones, Superintendent of the Albany Hospital, Albany, New York, will present the plan which has been developed in this hospital for organizing the entire personnel in case of such an emergency.

The afternoon session on Monday will be given over to significant discussions on convalescent care. The subject will be presented from the sociological and economic viewpoints by leading surgeons and others who have had experience with this problem in their respective communities. Fundamental principles in organizing for

adequate convalescent care of the surgical patient will be emphasized.

The Tuesday morning session of the hospital conference will include three important panel discussions. "The Control of Surgery," led by Dr. Harold Foss of Danville, Pennsylvania, "The Control of Infections," led by Dr. Frank L. Meleney of New York, and "The Physical and Administrative Hazards of Anesthesia," led by Dr. John S. Lundy of Rochester, Minnesota. These important panels will be of interest to both hospital personnel and surgeons.

The afternoon session will be devoted to a discussion of nursing problems in the hospital. A paper dealing with the "Essentials of Good Nursing Service" will be followed by a panel discussion on "Administration Costs of Nursing in the Hospital." A keenly debated subject, namely "The Accrediting of Schools of Nursing Education," will also be presented. On Tuesday evening a panel round table conference will cover all phases of organization, professional practice and public relations. These sessions will arouse the interest of all hospital visitors, particularly those who are charged with the responsibility of administration in the small hospital.

On Wednesday morning, at a joint session with the American Association of Medical Record Librarians, the following subjects will be discussed: "Adoption of the Standard Nomenclature," "Proposal of a Surgical Nomenclature," "Punch Card System," and "Relationship of the Medical Record Librarian to the Medical Staff." These subjects present pertinent problems in the organization of a medical records department in the hospital. The afternoon session on Wednesday will be devoted to demonstrations and group conferences covering administrative practices and professional procedures held in ten of the leading approved hospitals of the Chicago area. At the evening session the panel discussions will provide a means for presenting specific questions on hospital procedures to a group of leaders in the hospital field.

On Thursday morning the panel discussion will deal principally with the care of tuberculosis patients in general hospitals, the relation of the administration of the hospital to organized medicine, medical staff organization, health service for hospital personnel, and the cost of hospital care. The conference will close on Thursday afternoon with a series of group conferences and demonstrations dealing with administrative and professional practices in leading Chicago institutions.

A new feature has been added to the hospital program this year in the form of breakfast con-

ferences which will be held on Tuesday Wednesday and Thursday mornings. These will start promptly at 7:45 and end promptly at 9:15. While breakfast is being served there will be an opportunity for those attending to participate in a free and animated discussion of each subject under consideration. Each morning the speakers will be allowed ten minutes to present their subject, as follows: Tuesday morning, "The Hospital Administrators Program for Self Development" Wednesday morning, "The Medical Records Librarians Program for Self Development" Thursday morning, "The Public Relations Program of Your Hospital." Following these brief introductions to the subjects, each visitor attending the conferences will be called upon to give his or her reaction to the matter under discussion. As the attendance at these morning conferences is expected to be very large, arrangements will be made for visitors to register in advance for these sessions.

Perhaps the most important feature of the hospital conference will be the daily consultation service which will be provided. The information desk will be in charge of personnel of the Hospital Standardization Department of the College who will arrange for consultations on hospital problems with the field representatives of the organization and others who will be able to give authoritative information on various subjects. All who attend the hospital conferences are urged to present their particular problem and avail themselves of this service.

#### PUBLICATION OF PROCEEDINGS

As in former years, the formal papers which are presented at the scientific sessions of the Congress will be published in a special issue of the official journal of the College, *SURGERY GYNECOLOGY AND OBSTETRICS*, in February following the meeting. This is furnished without additional charge to all fellows, junior candidates, and others who register for the Congress as in-registered guests. The papers which are presented in connection with the Hospital Standardization Conference will be published in subsequent issues of the *Bulletin* of the American College of Surgeons.

#### AN EXHIBIT BY THE COLLEGE LIBRARY

The Library and Department of Literary Research will maintain a representative at the Clinical Congress for the purpose of outlining to visiting surgeons the services offered by the department and to list any studies which they may desire to undertake. Samples of the reprint col-

lections which are available through the package library service of the College library bibliography which have been compiled on specific subjects, and abstracts and translations from various languages will be shown. The exhibit will include charts and displays illustrating the interests of the bibliophile and the ways in which the College library can meet his needs. Visitors are invited to call upon the Librarian to consult with her with respect to their individual needs or their hospital medical library. Visitors are also invited to inspect the library on the upper floor of the John B. Murphy Memorial Building at 40 East Erie St.

#### ADVANCE REGISTRATION

The hospitals and medical schools of the Chicago area afford accommodations for a large number of visiting surgeons, but to insure against overcrowding attendance at the Congress will be limited to the number that can be comfortably accommodated at the clinics. The limit of attendance will be based on a survey determining the available facilities in the participating institutions. It is expected, therefore, that surgeons who wish to attend the Congress will register in advance.

A registration fee will be required in order to provide funds with which to meet expenses of the meeting. A formal receipt will be issued to each surgeon registering in advance which will be exchanged for a general admission card upon presentation at headquarters during the Congress. This card, which is not transferable, must accompany all requests for clinic tickets, tickets for the panel discussions and be presented for admission to the scientific sessions.

A resolution adopted by the Board of Regents provides that the registration fee for fellows of the College and endorsed junior candidates shall be \$5.00 that no fee for the 1940 Clinical Congress shall be required of initiates (class of 1940) that the fee for surgeons who are not fellows, attending as invited guests of the College, shall be \$3.00.

As in previous years, admission to clinics and demonstrations in the hospitals and certain of the scientific meetings at headquarters will be controlled by means of tickets. This plan provides for the distribution of tickets to visiting surgeons at the various clinics and other meetings and helps to insure against overcrowding. The number of tickets issued for any clinic or session will be limited to the capacity of the room in which the session is held. Visiting surgeons are urged to cooperate in making the clinic ticket plan a success.

## RAILROAD FARES

As no special rates have been authorized by the railroads of the United States or Canada for the 1940 Clinical Congress in Chicago, in accordance with the policy adopted by the railroads, no certificates will be required. However, round trip tickets to Chicago, sold at less than double the regular one-way fare, will be available from points in the United States and Canada. Return limit privileges of such round trip tickets are liberal but are not uniform in all sections of the country. In most instances the return limit is 30 days or more. Surgeons planning to attend the Congress should consult local ticket agents several days in advance of the date of the meeting for complete information as to the fares, routes, stopover privileges, and return limits on round trip tickets.

## HEADQUARTERS—TECHNICAL EXHIBITION

Headquarters for the Congress will be established at the Stevens Hotel where there are unusual facilities for accommodating the Congress. All of the public rooms have been reserved for conferences, registration, ticket bureaus, clinic bulletins, executive offices and scientific exhibits. Thus, all activities of the Congress, except the clinical program, will be located under one roof.

The technical exhibition together with the registration desk will be located on the lower floor of the Stevens Hotel in the large exhibition hall.

Leading manufacturers of surgical instruments and supplies, sutures, dressings, pharmaceuticals, operating room equipment, x-ray apparatus and hospital equipment of all kinds, as well as publishers of medical books, will be represented in the exhibition. It will provide for the visiting surgeons an opportunity of carefully inspecting the finest modern products of all those industries which are aiding the work of the surgeon and the hospital.

## CHICAGO HOTELS AND THEIR RATES

In addition to the headquarters hotel, the Stevens, there are several first-class hotels within short walking distance of headquarters, providing ample hotel facilities at reasonable rates. It is suggested that reservation of hotel accommodations be made at an early date. The following hotels are recommended by the Committee:

	Minimum Rate with Bath	
	Single	Double
Auditorium, 430 S. Michigan Ave.	\$2 50	\$4 00
Bismarck, 171 W. Randolph St.	3 50	5 00
Blackstone, Michigan Ave. at 7th St.	4 00	6 00
Congress, 500 S. Michigan Ave.	3 00	5 00
Drake, Michigan and Lake Shore Drive	4 00	6 00
Harrison, 57 E. Harrison St.	2 00	3 00
Lake Shore Drive, 181 Lake Shore Drive	4 00	6 00
LaSalle, 10 N. LaSalle St.	2 50	4 00
Morrison, 79 W. Madison St.	2 50	4 00
Palmer House, 15 E. Monroe St.	3 50	5 00
Sherman, 106 W. Randolph St.	2 50	4 00
Stevens, 720 S. Michigan Ave.	3 00	4 50

## ASSEMBLY OF INITIATES

*Monday, 3 00 p m , Auditorium, American College of Surgeons, 40 East Erie St*

Processional—Initiates, Officers, Regents, and Governors

Opening Remarks GEORGE P. MULLER, M D, Philadelphia, President.

The Program of the American College of Surgeons

ARTHUR W. ALLEN, M D, Boston, Vice Chairman, Board of Regents

BOWMAN C. CROWELL, M D, Chicago, Associate Director

MALCOLM T. MACEachern, M D, Chicago, Associate Director

The Fellowship Pledge Recital by Initiates

Greetings to the Initiates EVARTS A. GRAHAM, M D, St. Louis, President-elect

Closing Remarks IRVIN ABELL, M D, Louisville, Chairman, Board of Regents

Signing of the Fellowship Roll The Initiates

Reception by the officers and regents for the fellows and initiates and members of their families



## PROGRAMS FOR EVENING SESSIONS

*President at Meeting and Convocation—Monday 8.00 p.m.—Ballroom Stevens Hotel*

GEORGE P. MULLER, M.D. Philadelphia President, American College of Surgeons, Presiding.

Processional—Officers, Regents, and Honorary Guests.

Invocation.

Address of Welcome. JOHN A. WOLVER, M.D. Chicago Chairman, Committee on Arrangements.

Introduction of Foreign Guests. ARTHUR W. ALLEN, M.D. Boston Vice Chairman, Board of Regents.

Address of Retiring President The College and American Surgery GEORGE P. MULLER, M.D. Philadelphia.

Inauguration of Officers

President EVARTS A. GRAHAM, M.D. St. Louis.

First Vice President OLIVER S. WAUGH, M.D. Winnipeg

Second Vice President ALBERT O. SINGLETON, M.D. Galveston.

Presentation of Initiates for Fellowship IRVIN ABELL, M.D. Louisville Chairman, Board of Regents.

Conferring of Fellowships by the President. EVARTS A. GRAHAM, M.D. St. Louis.

Conferring of Honorary Fellowships. The President

Medical Records Prize Award

Annual Oration on Surgery Principles of Colonic Surgery FRED W. RANKIN, M.D. Lexington.

*Tuesday 8.00 p.m.—Ballroom Stevens Hotel*

EVARTS A. GRAHAM, M.D. St. Louis President, American College of Surgeons, Presiding

Surgical Complications in Pregnancy JOHN R. FRASER, M.D. Montreal

Aseptic Resections in the Gastrointestinal Tract, with Special Reference to Resection of the Stomach.

OWEN H. WANGENSTEEN, M.D. Minneapolis

Symposium The Esophagus.

Observations on the Diagnosis and Treatment of Caustic Burns, Cicatricial Stenosis and Achalasia GABRIEL TUCKER, M.D. Philadelphia.

Surgical Treatment of Achalasia. ALTON OCHSNER, M.D. and MICHAEL E. DEBARKY, M.D. New Orleans.

Recent Progress in the Surgical Treatment of Carcinoma of the Esophagus. WILLIAM E. ADAMS, M.D. Chicago.

*Wednesday 8.00 p.m.—Ballroom Stevens Hotel*

OLIVER S. WAUGH, M.D. Winnipeg Vice President, American College of Surgeons, Presiding

Sulfonamide Therapy as an Aid to Surgery JOHN S. LOCKWOOD, M.D. Philadelphia.

Oration on Traumatic Surgery Treatment of Tumors of Skin and Subcutaneous Tissues. FREDERICK W. BARCROFT, M.D. New York.

The Civilian Surgeon in War BRIGADIER GENERAL RAYMOND F. METCALFE, M.C. U.S.A. Washington.

A Brief Statement of the Work of the National Research Council Committee on Surgery in Connection with the Program of Military Preparedness. EVARTS A. GRAHAM, M.D. St. Louis.

*Thursday 8.00 p.m.—Ballroom Stevens Hotel*

ALBERT O. SINGLETON, M.D. Galveston Vice President, American College of Surgeons, Presiding

Gastrojejunocolic Fistula. DAMON B. FRIEDER, M.D. Philadelphia.

Some Factors Influencing the Controllability of Cancer of the Stomach. THOMAS F. MULLEN, M.D. San Francisco.

The Management of the Neurogenic Bladder in Traumatic Lesions of the Spinal Cord and Cauda Equina. REED A. NEUBART, M.D. Ann Arbor Mich.

Hepatic in Thrombosis and Blood Vessel Surgery. D. W. GORDON MURRA, M.D. Toronto.

## PROGRAMS FOR EVENING SESSIONS

## OPHTHALMOLOGY

*Tuesday, 8 00 p m —Stevens Hotel*

Panel Discussion Surgery of Squint WILLIAM THORNWALL DAVIS, M D , Washington, Presiding  
 Collaborators F BRUCE FRALICK, M D , Ann Arbor, Mich , SANFORD R GIFFORD, M D , Chicago

*Thursday, 8 00 p m —Stevens Hotel*

SANFORD R GIFFORD, M D , Chicago, Chairman, Advisory Council for Ophthalmology, Presiding  
 Symposium Advances of the Past Ten Years in Ophthalmic Surgery  
 Principles of Cataract Surgery JOHN H DUNNINGTON, M D , New York  
 Glaucoma Surgery ALGERNON B REESE, M D , New York  
 Retinal Detachment Surgery DERRICK VAIL, M D , Cincinnati

## OPHTHALMOLOGY AND OTORHINOLARYNGOLOGY

*Wednesday, 8 00 p m —Stevens Hotel*

HARRY S GRADLE, M D , Chicago, Regent, American College of Surgeons, Presiding  
 Symposium Treatment of Injuries about the Face  
 The Treatment of Injuries of the Globe and the Lids, and the Orbit EDMUND B SPAETH, M D , Philadelphia  
 Primary Care of Injuries of the Face and Jaws V H KAZANJIAN, M D , Boston  
 The Late Care of Severe Injuries of the Face and Jaws EARL C PADGETT, M D , Kansas City, Mo  
 Neurosurgical Aspects of Facial Injury HARRY H KERR, M D , Washington

## OTORHINOLARYNGOLOGY

*Tuesday, 8 00 p m —Stevens Hotel*

SAMUEL SALINGER, M D , Chicago, Member, Executive Committee on Arrangements Presiding  
 Symposium Ménière's Disease  
 Medical Treatment of Ménière's Disease HAROLD G TOBEY, M D , Boston  
 The Use of Histamine in Ménière's Disease BAYARD T HORTON, M D , Rochester, Minn  
 The Surgical Treatment of Ménière's Disease WALTER E DANDY, M D , Baltimore  
 General Discussion

*Thursday, 8 00 p m —Stevens Hotel*

GORDON B NEW, M D , Rochester, Minn , Member, Advisory Council for Otorhinolaryngology, Presiding  
 Body Section Roentgenography in Relation to Diagnosis in Diseases of the Nasal Accessory Sinuses  
 SHERWOOD MOORE, M D , and ALFRED J CONE, M D , St Louis  
 Tumors of the Upper Jaw, Particularly in Relation to the Sinuses CARL W WALDRON, M D , Minneapolis  
 History and Present Status of Operations on the Labyrinthine Capsule for Otosclerosis SAMUEL J KOPETZKY, M D , New York

## GROUP CLINICAL CONFERENCES

## GENERAL SURGERY AND SURGICAL SPECIALTIES

*Friday 100 p.m.—Sessions Held*

Treatment of Compound Fractures. GUY A. CALDWELL, M.D. New Orleans, Presiding

General Review GUY A. CALDWELL, M.D. New Orleans.

First Aid and Transportation Splinting. J. E. M. THOMSON, M.D. Lincoln, Neb.

Debridement and Operative Treatment. J. ALBERT KEY, M.D. St. Louis.

Methods of Splinting and Postoperative Treatment. HAROLD R. CONY, M.D. Akron, Ohio.

Orthopedic Surgery ARTHUR STENDLER, M.D. Iowa City, Presiding

Open forum.

Diagnosis and Treatment of Intrathoracic Tumors. FRANK S. DOLLEY, M.D. Los Angeles, Presiding

Mediastinal Tumors Amenable to Surgical Removal. FRANK S. DOLLEY, M.D. Los Angeles.

Bronchogenic Tumors. ALTON OCHSNER, M.D. New Orleans.

Bronchoscopic Considerations. CHEVALIER L. JACKSON, M.D. Philadelphia

Operative Technique. E. ARTHUR A. GRAHAM, M.D. St. Louis.

Open forum. JOHN ALEXANDER, M.D. Ann Arbor, Mich. Leader

Major Trigeminal Neuralgia. FRANCIS C. GRANT, M.D. Philadelphia, Presiding

General Discussion. FRANCIS C. GRANT, M.D. Philadelphia.

Importance of Alcohol Injection in the Treatment of Major Trigeminal Neuralgia. GILBERT HORRAX, M.D. Boston.

Total versus Subtotal Section of the Sensory Root. WATCHELL MCK. CRAIG, M.D. Rochester, Minn.

Operative Methods in Major Trigeminal Neuralgia. W. JAMES GARDNER, M.D. Cleveland.

Sensory Changes and the Prevention of Ocular and Other Complications Following Operation on the Sensory Root. LOYAL D. TH, M.D. Chicago

Malignancies of the Kidney and Ureter. T. LEON HOWARD, M.D. Denver, Presiding.

Wilms Tumors in Children. MEREDITH F. CAMPBELL, M.D. New York.

Hypernephroma. REED M. NEWITT, M.D. Ann Arbor, Mich.

Malignancies of the Ureter. VINCENT J. O'CONNOR, M.D. Chicago.

Papillary Carcinomas of the Kidney. W. CALVERT STERLING, M.D. Washington.

Deformities of the Ear. Congenital and Acquired. H. L. D. KIRKMAN, M.D. Houston, Texas, Presiding

Development of the Ear and Some Remarks on Lop Ears. DONALD W. MACCORMACK, M.D. Boston

The Physic Phases of Ear Deformities. VILRAY P. BLAIR, M.D. St. Louis

Lop Ears and Conditions Associated with Congenital Deformities. GORDO B. NEW, M.D. Rochester

Reconstruction of the Ear. GEORGE WARREN PIERCE, M.D. San Francisco. FERRIS SMITH, M.D. Grand Rapids, Mich.

Use of Preserved Ear Cartilage in Ear Reconstruction. H. L. D. KIRKMAN, M.D. Houston, Texas

The Management of Uterine Prolapse. LOUIS E. PRAXEUR, M.D. Boston, Presiding

The Anatomical Supports of the Uterus and Pelvic Viscera. F. EDWIN H. FALLS, M.D. Chicago.

The Intraperitoneal Operation (Wilkens) in the Management of Uterine Prolapse. WILLIARD F. MILLER, M.D. New Orleans

Vaginal Hysterectomy in the Management of Uterine Prolapse. ROBERT A. ROSS, M.D. Durham, N. C.

The Manchester Operation (Donald-Fothergill) in the Management of Uterine Prolapse. JOHN R. FRANK, M.D. Montreal.

Hernia of Douglas Cul-de-sac Complicating Uterine Prolapse. GEORGE GRAHAM, M.D. New York.

## OPHTHALMOLOGY AND OTORHINOLARYNGOLOGY

*Tuesday, 11 00 a m —Stevens Hotel*

Surgical Indications in Glaucoma HARRY S GRADLE, M D , Chicago, Presiding

Collaborators WALTER S ATKINSON, Watertown, N Y , EUGENE M BLAKE M D , New Haven, VIRGIL G CASTEN, M D , Boston, CARL FISHER, M D , Los Angeles, JONAS S FRIEDENWALD, M D , Baltimore, EVERETT L GOAR, M D , Houston, Texas, LOUIS S GREENE, M D , Washington, HENRY C HADEN, M D , Houston, Texas, SAMUEL J MEYER, M D , Chicago, CLARENCE A VEASEY, M D , Spokane, Wash

Rôle of Chemotherapy in Suppurative Diseases of the Middle Ear JOHN J SHEA, M D , Memphis, Tenn , Presiding

Collaborators ALBERT L BASS, M D , Louisville, JOSEPH C BECK, M D , Chicago, JAMES A FLYNN, M D , Washington, WILLIAM D GILL, M D , San Antonio, GORDON F HARNESS, M D , Davenport, M D , Duluth, M PAUL MOTTO, M D , Cleveland, BRITAIN FORD PAYNE, M D , New York, LYLE S POWELL, M D , Lawrence, Kans , ROY H PARKINSON, M D , San Francisco, COLVIN C PERDUE, M D , Mobile, CLARENCE H SMITH, M D , New York

*Wednesday, 11 00 a m —Stevens Hotel*

Surgical Management of Injuries to the Eye ARTHUR M CULLER, M D , Dayton, Ohio, Presiding

Collaborators LAWRENCE G DUNLAP, M D , Anaconda, Mont , ERLING W HANSEN, M D , Minneapolis, FREDERICK A KIEHLE, M D , Portland, Ore , DANIEL B KIRBY, M D , New York, FRANK N KNAPP, M D , Duluth, M PAUL MOTTO, M D , Cleveland, BRITAIN FORD PAYNE, M D , New York, LYLE S POWELL, M D , Lawrence, Kans , HARVEY E THORPE, M D , Pittsburgh, JOHN O WETZEL, M D , Lansing, Mich

Indications for Surgery in Sinus Disease SAMUEL IGLAUER, M D , Cincinnati, Presiding

Collaborators HOWARD C BALLENGER, M D , Winnetka, Ill , MATTHEW S ERSNER, M D , Philadelphia, ROBERT H FRASER, M D , Battle Creek, Mich , C H McCASKEY, M D , Indianapolis, SAMUEL SALINGER, M D , Chicago W LIKELY SIMPSON, M D , Memphis, Tenn

*Thursday, 11 00 a m —Stevens Hotel*

Minor Surgery in Ophthalmology MEYER WIENER, M D , St Louis, Presiding

Collaborators CLYDE A CLAPP, M D , Baltimore, RAY K DAILY, M D , Houston, Texas, THEODORE J DIMITY, M D , New Orleans, JAMES N GREER, JR, M D , Washington, WENDELL L HUGHES, M D , Hempstead, N Y , VINCENT L JONES, M D , St Louis, CLYDE E McDANNALD, M D , New York, LYLE S POWELL, M D , Lawrence, Kans , RALPH O RYCHENER, M D , Memphis, Tenn , WALTER STEVENSON, M D , Quincy, Ill

Osteomyelitis of the Skull Bones (Sinus and Mastoid Complications) THOMAS E CARMODY, M D , Denver, Presiding

Collaborators WILLIAM F CLEVINGER, M D , Indianapolis, DANIEL S CUNNING, M D , New York, JOSEPH E J KING, M D , New York, FRANCIS L LEDERER, M D , Chicago, EDWARD A LOOPER, M D , Baltimore, WILLIAM J MELLINGER, M D , Santa Barbara, Calif , ABRAHAM O WILENSKY, M D , New York.

## GRADUATE TRAINING IN SURGERY

*Thursday, 3 00 p m —Ballroom, Stevens Hotel*

DALLAS B PHEMISTER, M D , Chicago, Chairman, Committee on Graduate Training for Surgery, Presiding

The Rôle in a Teaching Program for Graduate Training in Surgery of a Hospital without University Connections CHARLES A BOWERS, M D , Cleveland

Open forum Graduate Training in General Surgery and the Surgical Specialties ROBIN C BUERKI, M D , Madison, Wis , Leader

Duration of training and objective    Organization and supervision    Basic medical sciences    Clinical material    Organized study

## PANEL DISCUSSIONS

*Monday 1:30 to 3:00 p.m. — Stevens Hotel*

- Treatment of Acute Cholecystitis. JOHN L. ATLEY JR., M.D. Lancaster Pa. Presiding.  
 Collaborators FREDERICK E. KREDEL, M.D. Charleston S. C. KENT W. BARBER, M.D. Quincy Ill.  
 J. LOUIS RANBOHOFF, M.D. Cincinnati.
- Dislocation of the Intervertebral Disc. FRANK D. DEERSON, M.D. Kansas City Mo., Presiding.  
 Collaborators W. JASON MIXTER, M.D. Boston LEWIS J. POLLOCK, M.D. Chicago EDGAR F. FINCHER, M.D. Atlanta Ga.
- The Treatment of Endocrine Sterility in Women. EDWIN C. HAMBLEY, M.D. Durham, N. C., Presiding.  
 Collaborators JOHN C. BURCH, M.D. Nashville CONRAD G. COLLIER, M.D. New Orleans.
- Complications of Thyroid Surgery. FRANK H. LAHEY, M.D. Boston, Presiding.  
 Collaborators HAROLD L. FORD, M.D. Danville, Pa. S. L. LINDGATTER, JR., M.D. Birmingham Ill. H. SEARLES, M.D. San Francisco.
- Place of Irradiation Treatment in Cancer of the Breast. E. P. PENNINGER, M.D. Philadelphia, Presiding.  
 Collaborators FRANK E. ADAMS, M.D. New York ALBION R. KILGORE, M.D. San Francisco JAMES F. KELLY, M.D. Omaha STUART W. HARRINGTON, M.D. Rochester Minn.

*Monday 3:30 to 5:00 p.m. — Stevens Hotel*

- Abdominal Trauma. FREDERICK A. BENTLEY, M.D. Waukegan Presiding.  
 Collaborators JOHN H. MULLIGAN, M.D. New York FRED W. BAILEY, M.D. St. Louis ANDREW H. STOKES, M.D. New Orleans.
- Carcinoma of the Colon. FREDERICK A. COLLIER, M.D. Ann Arbor Mich. Presiding.  
 Collaborators VERNON C. D. VID, M.D. Chicago CLAUD F. DIXON, M.D. Rochester Minn. THOMAS E. JONES, M.D. Cleveland.
- Indications for Colectomy Section. S. A. COSGROVE, M.D. Jersey City N. J. Presiding.  
 Collaborators JAMES RAGLAN MILLER, M.D. Hartford H. HUTCHALL WALKER, JR., M.D. Richmond.
- Management of Acute Perforated Appendicitis. VERNON C. HUNT, M.D. Los Angeles, Presiding.  
 Collaborators LAWRENCE S. FALLER, M.D. Detroit WILLIS D. GATCH, M.D. Indianapolis HEYAT K. RAMSON, M.D. Ann Arbor, Mich.
- Subacromial Bursitis. HENRY W. MYERDING, M.D. Rochester Minn., Presiding.  
 Collaborators EARL D. McBRIDE, M.D. Oklahoma City CLAY RAY MURRAY, M.D. New York R. H. FREYBERG, M.D. Ann Arbor Mich.

*Tuesday 1:30 to 3:00 p.m. — Stevens Hotel*

- Atypical Giant Cell Tumors of Bone. BRADLEY L. COLEY, M.D. New York, Presiding.  
 Collaborator DALLAS B. PRICKSTER, M.D. Chicago.
- Nutritional Status of the Patient (Vitamins, Proteins). L. KRAFFT FERGUSON, M.D. Philadelphia Presiding.  
 Collaborators JOHN B. HARTZELL, M.D. Detroit A. C. IVEY, M.D. Chicago CHARLES C. LUDWIG, M.D. Boston.
- Management of Infections of the Urinary Tract. CHARLES C. HIGGINS, M.D. Cleveland, Presiding.  
 Collaborators HENRY O. MERRITT, M.D. Indianapolis JOHN K. ORMOND, M.D. Detroit IRA R. SISK, M.D. Madison, Wis.
- Acute Abdominal Surgery in Children. THOMAS H. LAMMAN, M.D. Boston, Presiding.  
 Collaborators EDWARD J. DONOFRAN, M.D. New York WALTER ESTELL LEE, M.D. Philadelphia W. J. POTTS, M.D. Oak Park, Ill.
- Tumors of the Salivary Glands. ALBERT O. STONINGTON, M.D. Galveston Presiding.  
 Collaborators EDWIN I. BARTLETT, M.D. San Francisco FREDERICK A. FICI, M.D. Rochester Minn. R. B. MALCOLM, M.D. Chicago.

*Tuesday 3:30 to 5:00 p.m. — Stevens Hotel*

- Surgery Pulmonary Tuberculosis. LEO ELOVETZ, M.D. San Francisco, Presiding.  
 Collaborators CARPENTER F. HIGGINS, M.D. Denver RICHARD H. MEADE, JR., M.D. Philadelphia VICTOR STROGO RANDOLPH, M.D. Phoenix, Ariz.
- Early Recognition of Cancer of the Uterine Cervix and of the Corpus. WILLIAM P. HEALY, M.D. New York, Presiding.  
 Collaborators NORMAN F. MILLER, M.D. Ann Arbor Mich. FRED J. TAUBIG, M.D. St. Louis RAYMOND E. W. THOMAS, M.D. Portland, Ore.

- Intestinal Obstruction THOMAS G ORR, M D , Kansas City, Mo , Presiding  
 Collaborators M J HENRY, M.D , Louisville, CHARLES G JOHNSTON, M D , Detroit, MIMS GAGE, M D ,  
 New Orleans
- Surgical Diseases of the Pancreas ALLEN O WHIPPLE, M D , New York, Presiding  
 Collaborators ALEXANDER BRUNSCHWIG, M D , Chicago, JOHN MILTON McCAUGHAN, M D , St. Louis

*Wednesday, 1 30 to 3 00 p m —Stevens Hotel*

- Tumors of the Urinary Bladder HENRY G BUGBEE, M D , New York, Presiding  
 Collaborators LOUIS M ORR, M D , Orlando, Fla , CARL RUSCHE, M D , Los Angeles
- Etiology and Treatment of Gastric Hemorrhage ROSCOE R GRAHAM, M D , Toronto, Presiding  
 Collaborators HOWARD M CLUTE, M D , Boston, J WILLIAM HINTON, M D , New York, J SHELTON  
 HORSLEY, M D , Richmond
- Anesthesia in Cranial Surgery GILBERT HORRAX, M D , Boston, Presiding  
 Collaborators MAX MINOR PEET, M D , Ann Arbor, Mich , JOHN S LUNDY, M D , Rochester, Minn
- Healing of Wounds SUMNER L KOCH, M D , Chicago, Presiding  
 Collaborators LAWRENCE CHAFFIN, M D , Los Angeles, R ARNOLD GRISWOLD, M D , Louisville, EDWARD  
 L HOWES, M D , Washington
- Liver Tests and Liver Function in Relation to Biliary Surgery I S RAVDIN, M D , Philadelphia, Presiding  
 Collaborators CHARLES B PUESTOW, M D , Chicago, HOWARD K GRAY, M D , Rochester, Minn ,  
 HENRY W CAVE, M D , New York

*Wednesday, 3 30 to 5 00 p m —Stevens Hotel*

- Penetrating Wounds of the Brain C C COLEMAN, M D , Richmond, Presiding,  
 Collaborators WALLACE B HAMBY, M D , Buffalo, HOWARD C NAFFZIGER, M D , San Francisco, BYRON  
 STOOKEY, M D , New York
- Colles' Fracture PAUL B MAGNUSON, M D , Chicago, Presiding  
 Collaborators ROBERT H KENNEDY, M D , New York, ROBERT D SCHROCK, M D , Omaha, GEORGE E  
 WILSON, M D , Toronto
- Infections of the Hand MICHAEL L MASON, M D , Chicago, Presiding  
 Collaborators HOMER D DUDLEY, M D , Seattle, HENRY C MARBLE, M D , Boston, JAMES M WIN-  
 FIELD, M D , Detroit
- Surgical Bacteriology FRANK L MELENEY, M D , New York, Presiding  
 Collaborators J DERYL HART, M D , Durham, N C , EDMUND ANDREWS, M D , Bloomington, Ill ,  
 WILLIAM A ALTEMEIER, M D , Cincinnati
- Immediate Treatment of Burns GROVER C PENBERTHY, M D , Detroit, Presiding  
 Collaborators HARRY C HULL, M D , Baltimore, EDMUND BUTLER, M D , San Francisco, DONALD B  
 WELLS, M D , Hartford
- Motion Picture Final Results Obtained in the Free Skin Grafting of Burns JAMES BARRETT BROWN,  
 M D , and FRANK MCDOWELL, M D , St. Louis

*Thursday, 3 30 to 5 00 p m —Stevens Hotel*

- Anesthesia, Analgesia, and Amnesia in Obstetrics LOUIS H DOUGLASS, M D , Baltimore, Presiding  
 Collaborators FREDERIC SCHREIBER, M D , Detroit, PAUL TITUS, M D , Pittsburgh, RALPH M TOVELL,  
 M D , Hartford
- Non malignant Diseases of the Intestines THOMAS E JONES, M D , Cleveland, Presiding  
 Collaborators IRVIN ABELL, M D , Louisville, J L McGEHEE, M D , Memphis, CHARLES W MAYO,  
 M D , Rochester, Minn
- Anesthesia in Abdominal Surgery ERWIN R SCHMIDT, M D , Madison, Wis , Presiding  
 Collaborators VIRGINIA APGAR, M D , New York, CHARLES J BETLACH, M D , Chicago, F W HART-  
 MAN, M D , Detroit
- Suppurative Conditions of the Lung NORMAN S SHENSTONE, M D , Toronto, Presiding  
 Collaborators WILLIAM F RIENHOFF, JR , M D , Baltimore, WILLIAM A HUDSON, M D , Detroit, PAUL  
 C SAMSON, M D , Oakland, Calif
- Management of Gangrene in Diabetics ARTHUR A ZIEROLD, M D , Minneapolis, Presiding  
 Collaborators WALTER H NADLER, M D , Chicago, JOSEPH B PRIESTLEY, M D , Des Moines, BEVERLY  
 CHLW SMITH, M D , New York

## PROGRAMS FOR AFTERNOON SESSIONS

## SYMPOSIUM ON FRACTURES AND OTHER TRAUMAS

*Tuesday 3:00 p.m.—Sterens Hall*

ROBERT H. KENNEDY, M.D., New York, Chairman, Committee on Fractures and Other Traumas, Presiding.  
Results of Fractures of the Tibia and Fibula Treated by Skeletal Traction and Braun-Böhler Splint.  
HURLEY R. OWEN, M.D., Philadelphia.

The Recognition and Early Treatment of Injuries of the Genito-Urinary Tract. ALEXANDER HAMILTON PEACOCK, M.D., Seattle, Wash.

Fractures Due to Muscular Violence. FRANK P. STRICKLER, M.D., Louisville.

Undergraduate Education in Fractures and Other Traumas. CLAY RAY MURRAY, M.D., New York.

Extracranial Hemorrhage Following Trauma. J. DENT HART, M.D., and BARBARA WOODHALL, M.D., Durham, N.C.

Fractures Involving the Ankle Joint. RALPH G. CAROTHERS, M.D., Cincinnati.

## SYMPOSIUM ON CANCER

*Wednesday 3:00 p.m.—Sterens Hall*

FRANK E. ADAMS, M.D., New York, Chairman, Cancer Committee, Presiding.

Neurogenic Sarcoma. DONALD V. TRUEBLOOD, M.D., Seattle.

Present Status of Carcinogens and Hormones in Cancer Research. JOHN J. MORTON, M.D., Rochester, N.Y.

Radiation Damage to Tissues and Its Repair. ERNEST M. DALAND, M.D., Boston.

The Present Status of the Treatment of Gynecologic Cancer with Especial Reference to Results Obtained by Roentgenotherapy. GEORGE KAMPERMAN, M.D., Detroit.

## COMMITTEE ON ARRANGEMENTS

## EXECUTIVE COMMITTEE

John A. Waller	Warren H. Cole
Chairman	Vernon C. David
Charles B. Puustow	Marshall Davidson
Secretary	Harry S. Gruffie
Fred L. Adair	Michael L. Mason
William E. Adams	Oscar E. Nielsen
William J. Baker	Eric Oldberg
Frederic A. Besley	Samuel Sellinger
Alexander Brunschwig	Charles F. Sawyer
Fremont A. Chandler	Kellogg Speed

## HOSPITALS AND REPRESENTATIVES

Alexian Brothers—George L. Apfelbach  
Augustana—Oscar E. Nielsen  
Albert Merritt Billings and Bobb Roberts Memorial—Dallas B. Plummer  
Chicago Lying-in—Fred L. Adair  
Chicago Memorial—Peter S. Clark  
Children's Memorial—Albert H. Montgomery  
Calumet—Daniel A. Orth  
Cook County—Marshall Davidson  
Evangelical—G. Henry Minard  
Evangelist—Frederick Christopher  
Grant—A. G. Zimmerman  
Hennrich—John A. Graham  
Holy Cross—John F. Rustic

Illinois Eye and Ear Infirmary—Thomas D. Allen  
Illinois Masonic—Walter C. Bornsander  
Jackson Park—Arrie Baumberger  
Loretto—James A. Valentine  
Merry—Charles F. Sawyer  
Michael Reese—Ralph B. Bettinson  
Mother Cabrini—Eugene J. Chesrow  
Mount Sinai—Jacob M. Nora  
Municipal Tuberculosis Sanitarium—Richard Devlin  
Norwegian-American—Harold A. Söfkel  
Pauzanov Memorial—Loyal Davis  
Presbyterian—Vernon C. David  
Ravenwood—Darius B. Peod  
Research and Educational—Warren H. Cole  
St. Anne's—George F. Thompson  
St. Anthony de Padua—Frederick W. Globe  
St. Bernard's—John G. Frost  
St. Elizabeth's—Martin G. Lukes  
St. Joseph—Hugh McKenna  
St. Luke's—Selma W. McArthur  
St. Mary of Nazareth—George M. Mueller  
Shriners for Crippled Children—Beveridge H. Moore  
Swedish Covenant—Karl L. Vahr  
Veterans Administration—Paul F. Brown  
Washington Boulevard—Arthur R. Metz  
Wesley Memorial—Raymond W. McNeely  
Women and Children's—Maude H. Wickett

## ANNUAL HOSPITAL STANDARDIZATION CONFERENCE

*Monday, 10 00 a m —Ballroom, Stevens Hotel*

GEORGE P. MULLER, M D, Philadelphia, President, American College of Surgeons, presiding  
 Address of the President—The Hospital Program of the American College of Surgeons  
 Report of the 1940 Hospital Standardization Survey—Official Announcement of the List of Approved Hospitals IRVIN ABELL, M D, Louisville, Chairman, Board of Regents, American College of Surgeons  
 Report on Graduate Training in Surgery DALLAS B. PHEMISTER, M D, Chicago  
 The Hospital of Tomorrow REV A. M. SCHWITALLA, S J, St. Louis, President, Catholic Hospital Association  
 Medical Preparedness for National Emergency ROSS T. MCINTIRE, M D, Washington, Surgeon General, United States Navy  
 Preparedness for National Emergency from the Standpoint of the Hospital E. W. JONES, Albany, N Y  
 The Effect of the Present Trend in Specialization in Medicine on Hospital Administration and Service BENJAMIN W. BLACK, M D, Oakland, Calif., President, American Hospital Association  
 Discussion Led by EVARTS A. GRAHAM, M D, St. Louis, President-Elect, American College of Surgeons

*Monday, 2 00 p m —Ballroom, Stevens Hotel*

HARRY E. MOCK, M D, Chicago, presiding  
 Convalescent Care—The Missing Link in the Cure of Many Patients HARRY E. MOCK, M D, Chicago  
 Socio-Economic Aspects of Convalescent Care ELIZABETH G. GARDINER, New York  
 Minimum Standards for Convalescent Hospitals E. H. L. CORWIN, Ph D, New York  
 Essentials in Planning of Institutions for Convalescent Care WILLIAM H. WALSH, M D, Chicago  
 Institutional Convalescent Care for Various Types of Patients  
 The Surgical Patient. DONALD B. WELLS, M D, Hartford, Conn  
 The Medical Patient NEWELL C. GILBERT, M D, Chicago  
 The Cancer Patient. FRANK E. ADAIR, M D, New York  
 The Fracture Patient. ROBERT H. KENNEDY, M D, New York  
 The Orthopedic Patient. FREDERICK C. KIDNER, M D, Detroit  
 The Pediatric Patient. LOUIS A. SCHWARTZ, M D, Detroit  
 General discussion Opened by KARL A. MEYER, M D, Chicago, JOHN S. COULTER, M D, Chicago, JOSEPH KING, Chicago

*Monday, 4 30 p m —Lounge, 2nd Floor, Stevens Hotel*

Consultation Service Administrative practices and policies, medical staff problems and medical records, pathological service, business management, patients' library service, hospital standardization problems

*Tuesday, 7 45 a m —Private Dining Room, Stevens Hotel*

Breakfast Conference, Sponsored by the American College of Hospital Administrators in co-operation with the American College of Surgeons The Hospital Administrators' Program for Self Development. ARTHUR C. BACHMEYER, M D, Chicago, presiding

## Discussion from the following aspects

Institutes for Hospital Administrators BENJAMIN W. BLACK, M D, Oakland, Calif  
 Apprenticeship Training CLAUDE W. MUNGER, M D, New York  
 Self Study and Personal Development. JOSEPH G. NORBY, Milwaukee  
 General discussion Opened by FLORENCE KING, St. Louis

*Tuesday, 9 30 a m —Upper Tower Ballroom, Stevens Hotel*

GUY M. HANNER, Colorado Springs, Colo, presiding  
 Greetings from the American Protestant Hospital Association GUY M. HANNER, Colorado Springs, Colo  
 Panel Discussions

Qualifications for Performing Major Surgery Conducted by HAROLD L. FOSS, M D, Danville, Pa.

## Discussion from the standpoints of

The Practical Application of a Plan for the Control of Major Surgery in an Open Hospital E. MAC DONALD STANTON, M D, Schenectady, N Y

Organization of the Medical Staff in Relation to the Control of Major Surgery CLARENCE E. REES, M D, San Diego, Calif

The Respective Roles of the Professional and Administrative Staffs in the Control of Postoperative Infections Conducted by FRANK L. MELENY, M D, New York.

## Discussion from the standpoints of

Bacteriologist WILLIAM F. PETERSEN, M D, Chicago  
 Operating Room Supervisor MARGARET K. SCHAFER, Ann Arbor, Mich

Anesthesia Hazards Conducted by JOHN S. LUNDY, M D, Rochester, Minn.

## Discussion from the standpoints of

Physical Hazards—Explosibility and Inflammability RALPH M. TOVELL, M D, Hartford, Conn

Administrative Hazards—The Administration of Anesthesia by Inexperienced Persons HENRY S. RUTH, M D, Merion, Pa.

*Tuesday, 2 00 p m —Upper Tower Ballroom, Stevens Hotel*

Conference on Nursing Service and Nursing Education NELLIE X. HAWKINSON, R N, Chicago, presiding  
 Essentials of Good Nursing Care of the Patient. SISTER M. BERENICE, R N, Milwaukee

## Panel Discussions

Administrative Costs of Nursing Based on Recent Study and Published Report. CLAUDE W. MUNGER, M D, New York

## Discussion from the viewpoints of

Special Problems in the Separation of Nursing Education and Nursing Costs CHARLES A. ROVETTA, Chicago

The Responsibility and Contribution of the Nursing Administrator in a Nursing Cost Study BLANCHE PFEFFERKORN, R N, New York

Accounting in Nursing Costs C. RUFUS ROREM, Ph.D, Chicago

The General Plan for Accrediting Schools of Nursing ELIZABETH C. BURGESS, R N, New York.

## Discussion from the viewpoints of

Nursing Education GEORGE A. WORKS, Chicago  
 Nursing Administration MARGARET CARRINGTON, R N, Chicago

Hospital Administration ROBIN C. BUEKEL, M D, Madison, Wis



*Tuesday 4:30 p.m.—Low 2d Floor Stevens Hotel*  
 Consultation Service: Administrative practices and policies operating room management, small hospital problems, public relations, outpatient department management, hospital standardization problems.

*Tuesday 7:00 p.m.—Upper Tower Ballroom, Stevens Hotel*  
 Motion pictures.

Panel Round Table Conference: Organization, Management, and Special Problems of the Small Hospital. A. F. BRANTON, M.D., William Allen, presiding.

Personnel—Securing and Maintaining Competent Administrative and Other Personnel. MARJORIE M. INCE, R.N., Highland Park, Ill.

Medical Staff—Organizing and Functioning of the Medical Staff. F. JAMES G. VEE, R.N., Alton, Ill.

Adjuvant Services—Providing Adequate Laboratory X-ray and Other Essential Services for the Treatment of the Patient. F. P. McNAMARA, M.D., Dubuque, Iowa.

Medical Records—Securing Good Medical Records. ALICE G. KIRKLAND, M.D., Electric M.D.s, Mass. Nursing—Providing Efficient Nursing Service. MARIE L. KIRKLAND, R.N., Louisville.

Fluoroscopic—Meeting the Problem of Fluoroscopic. VICTOR S. LEMMON, Washington, Ill.

The Women's Auxiliary—Organization, Management, and Special Problems. MISS G. E. GOODYEAR, Hastings, Mich.

Public Relations—Promoting Public Relations Program. CHARLOTTE GARRISON, R.N., Battle Creek, Mich.

Hospital Standardization—Meeting the Requirements for Approval by the American College of Surgeons. E. W. WILLIAMSON, M.D., Chicago.

Collaborators. GRACIE L. D. VEE, Battle Creek, Mich. P. H. FOSTER, Vespertine, Miss.

*Wednesday 7:45 a.m.—Breakfast During Room, Stevens Hotel*  
 Breakfast Conference, Sponsored by the American Association of Medical Record Librarians in co-operation with the American College of Surgeons. The Medical Records Librarians' Program for Self Development. RA. M. ANDERSON, Minneapolis, presiding.

Discussion from the following aspects:

Approved Courses for Medical Records Librarians. ALICE G. KIRKLAND, Oakland, Calif.

Need for Courses for Medical Records Librarians Already in the Field. ED. K. HOFFER, Chicago.

Self Study and Personal Development. MARGUERITE E. BOONLEY, Pittsburgh.

General Discussion. Opened by SISTER M. F. TUCKER, Duluth.

*Wednesday 9:30 a.m.—Upper Tower Ballroom, Stevens Hotel*  
 Joint Conference with American Association of Medical Record Librarians. ROBERT C. BUTLER, M.D., Madison, presiding.

Greetings from the American College of Surgeons to the American Association of Medical Record Librarians. MALCOLM T. MACFARLANE, M.D., Chicago.

Personal, Professional, and Other Qualifications of Successful Medical Records Librarians. DOMITRIKA M. THOTTVA, R.R.L., Grand Rapids, Mich.

Governing Principles of the Medical Records Librarian in Her Relations with the Resident Staff. SISTER MARY SEVY, R.R.L., St. Louis.

The Adoption and Putting Into Operation of the Standard Medical Nomenclature. EDWIN P. JORDAN, M.D., Chicago.

Surgical Nomenclature. HILTON P. JENNINS, M.D., Chicago.

The Practical Application of the French Card System in Assembling Statistical and Research Data from the Medical Records. JAMES L. HARRISON, R.R.L., Durham, N.C.

Diagnostic Code for Use in Tabulating Morbidity Statistics. HILBERT L. DEVER, M.D., Washington, Chief Statistician for Vital Statistics of the United States Bureau of Census.

Open Forum Discussion: Problems Pertaining to the Obtaining of Good Medical Records. Conducted by ROBERT C. BUTLER, M.D., Madison, Wis.

*Wednesday 2:00 p.m.—Lounge and Floor Stevens Hotel*  
 Consultation Service: Administrative practices and policies, internships and residencies, physical therapy-obstetrical services in the hospital, legal aspects of the hospital, hospital standardization problems.

*Wednesday 3:00 p.m.—Local Hospitals*  
 Group Conferences and Demonstrations.

Augustana Hospital. E. L. EICKHOFF, Superintendent.

Central Service for Dressings. AGNES HANSON, R.N.

Rehabilitation and Modernization of the X-ray Department. D. VAN S. BRILL, M.D.

Management of the Pharmacy Service. FRANCIS DOUGLAS, Ph.D.

Children's Memorial Hospital. MARIE W. BREWER, R.N., Superintendent.

Outpatient Clinic Management—Inspection of New Clinic Building. BARRETT S. JORDON.

Organization and Management of Laundry and Linen Service. ALON J. ULANCI.

Purchasing and Stores. CAROL H. JONES.

Cook County Hospital. GENERAL MARGIE McCORMICK, Warden.

Central Control of Parenteral Solutions. FREDERICK STROMMANN, M.D.

Preservation and Use of Medical Records in Large Hospital. STELLA FORB WALKER.

Organization and Management of Blood Bank Service. LILIANETTE SCHMIDTKE, M.D.

Grant Hospital. CLYTON F. SATTIE, Administrator.

Central Stores, Perpetual Inventory; Purchasing. ROBERT A. SCOTT.

Central Service. MARGARET KARTEN MINTLE.

Medical Records Librarians' School. EDNA K. HOFFMAN.

Department of Nursing Conference. Furthering Ward Instruction and Ward Supervision. ELIZABETH C. WYTEL, R.N.

Harrold Hospital. VERONICA MILLER, R.N., Administrator.

Office Management. HENRIETTA DRAGER.

Central Control of Supplies. MELBRED KRAVITZ, R.N.

Housekeeping. MELBRED KRAVITZ.

Michael Reese Hospital. ALBERT H. SCHMIDT, Associate Director.

Personnel Management. GEORGE PICK.

Clinic Management and Medical Social Service. ELIZABETH MCCONNELL and LEMMONA RICHMOND.

Modern Laundry Methods. R. J. GABRIELSON.

Presbyterian Hospital. AS. S. BACON, Superintendent.

Personality in the Hospital—the Front Office—Contact and Dealing with Patients, Relatives, and Friends. AS. S. BACON.

Business Methods—Accounting, Purchasing, Income, Charges, Control. HENRY HAYWAT and L. D. RYAN.

Centralized Food Service. BEULAH HENDERSON.

# PROGRAM FOR THE CHICAGO CLINICAL CONGRESS

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General Discussion Led by CHARLES S. WOODS, M.D.,  
Peoria, Ill

Thursday, 2:30 p.m. — Local Hospitals

Group Conferences and Demonstrations  
Chicago Lying In Hospital and Dispensary S. A. IERGISON, Assistant to Director  
Registration and Admission JEAN B. ANDERSON  
Isolation of Obstetrical Patients GEORGIA HILL, R.N.  
Nursery Management GEORGIA HILL, R.N.  
Mount Sinai Hospital ST. PHILIP MANHEIMER, M.D., Director  
Medical Staff Organization and Administrative Control ST. PHILIP MANHEIMER, M.D.  
Clinical Laboratory — Organization, Management and Service I. DAVIDSON, M.D.  
Business Management — Accounting, Purchasing and Revenue NATHAN W. HELMAN, C.P.A.  
Passavant Memorial Hospital IRVING S. CUTLER, M.D., Superintendent  
Oxygen Therapy M. HERBERT BARKER, M.D.  
Physical Therapy JOHN S. COULTER, M.D.

Engineering and Maintenance WILLIAM W. DAWSON  
Ravenswood Hospital J. DWYER LUTES, Administrator  
General Administration of a 200 Bed Hospital J. DWYER LUTES  
Medical Records Department HELENA BENEDICT  
Medical Library LIONORA PERRY  
Research and Educational Hospitals MAJOR H. WORTHINGTON, M.D., Managing Officer  
Psychiatry in a General Hospital Inspection of New Central Supply Building I. R. SONNENHAL, M.D.  
Central Supply Service and Central Linen Exchange ANN LUCILE LAMB  
Study Tour of Orthopedic Hospital ANTONETTE J. RADIN, R.N., Assistant Chief Nurse  
St. Elizabeth Hospital SISTIE M. ADOLPHINE, R.N., Superior  
Obstetrical Department in a General Hospital J. R. LAWRIE, M.D.  
Central Supply Service SISTIE M. MARCANTIS, R.N.  
Modernized Nursery Technique MAURIE DALTON, R.N.  
St. Luke's Hospital CHARLES A. WORTH, Director  
Business Methods — Accounting, Purchasing, Stores, Preparation of Budget, Monthly Reports I. FIDOFFICI, T. MURPHY  
Equipment and Procedures for Dressing Cart, Modified Wingensteen or Gravity Suction LILLIAN VAN DIEST, ST. LUKE'S

Set Up in Major Operating Rooms with Special Reference to Personnel Blood Transfusions MAURIE DALTON  
Wesley Memorial Hospital I. R. SONNENHAL, Superintendent  
Practical Problems in Anesthesia and Oxygen Therapy MARY KAY, M.D.  
Food Service LILLIAN H. TUST  
Obstetrical Procedures ALBERT J. JOHNSON  
West Suburban Hospital I. CAWORTH, Superintendent  
Management of the Newborn Humility a Doctor at Nursery Safeguard I. FROST, SCHULZ, R.N. MARY MURPHY, R.N. and I. CAWORTH, R.N.  
Pulmonary Identification GILBERT P. FORD, M.D.  
Maintenance of the Physical Plant and Engineering DAVID PARRON  
Woodlawn Hospital GEORGE I. DEWITT, R.N., Superintendent  
Study of Organization Management and Procedures in a Private Hospital of 100 Bed Capacity I. DEWITT, R.N., and Staff

St. Joseph Hospital SISTIE ZITA A.M. Administrator  
Organization and Management of the Obstetrical Department Rehabilitation of the Physical Plant CLAUDI GRIFFIN, M.D., and LILLY M. COULTER  
Operating Room Management Technique and Procedures, Rehabilitation of the Physical Plant SISTIE DILLON, R.N., B.S.  
Food Administration SISTIE RIFINA, R.N., B.S.  
University of Chicago Clinics C. OTIS WHITTECOTTON, M.D., Superintendent  
Anesthesia Operating Room Management and Technique HUMBERTA LIVINGSTON, M.D., and DOROTHY SCHMIDT, R.N.  
Food Service LILLIAN M. FEE  
Medical Records Library, Creation of a Medical Record ADMINIS. HAYDEN  
Women and Children's Hospital IDNA H. NELSON, Superintendent  
Mother's Milk Bureau MARION GRIFFIN  
Care of Newborn MARI HANLAN  
Obstetrical Technique and Procedures BLATRICE I. TICKLER, M.D.

Wednesday, 7:00 p.m. — Upper Tower Ballroom, Stevens Hotel  
Motion pictures  
Departmental Panel Round Table Conference Conducted by RONALD C. BURKE, M.D., Madison, Wis., and MALCOLM I. MACLENNAN, M.D., Chicago  
Administrative Practices THOMAS T. MURRAY, Albany  
Anesthesia Service HUGH A. CANNINGHAM, M.D., Milwaukee  
Business Management WILLIS J. GRAY, Detroit  
Food Service HELEN MAE BRYAN, Chicago  
Laundry and Linen Service ALOIS J. ULRICH, Chicago  
Medical Records MARIANNE C. TAYLOR, Rochester, N.Y.

Medical Social Service JOSEPHINE G. TAYLOR, Chicago  
Medical Staff CHARLES B. PERSTON, M.D., Chicago  
Nursing Service ELIZABETH ODELL, Evanston, Ill.  
Obstetrical Service CARL P. HUBB, M.D., Indianapolis  
Outpatient Department ALVA VAHL, Milwaukee  
Pathological Service JAMES G. MONTGOMERY, M.D., Muncie, Ind.  
Patients' Libraries SILVIA LINDEN, Chicago  
Physical Therapy JOHN S. COULTER, M.D., Chicago  
Tuberculosis M. POLLAK, M.D., Peoria, Ill.  
Urology OSCAR OLSON, Madison, Wis.  
X-ray Service JAMES T. CASE, M.D., Chicago

Thursday, 7:45 a.m. — Private Dining Room, Stevens Hotel  
Breakfast Conference The Public Relations Program of Your Hospital ALBERT B. MILLS, Chicago, presiding  
Discussion from the following reports:  
Newspaper Publicity JAMES JACOBSON, Chicago  
Annual Reports ANNA BECK, Chicago  
Syndicated Material ALBERT G. HARRIS, Evanston, Ill.  
Fund Raising ANNA B. MCCLURE, R.N., Evanston, Ill.  
General Discussion Opened by CARL E. FLATH, Detroit

Test Dinner 8:00 a.m. Upper Tower Ballroom, Stevens Hotel  
LAWRENCE BEAUMONT, M.D., St. Louis, presiding  
Hospital Administration and Its Relation to Organization  
Medicine ROBERT L. HENDERSON, Brooklyn  
The Problem of Tuberculosis in the General Hospital JAMES T. MURPHY, M.D., Oak Terrace, Minn.  
An Outpatient Health Service for Hospital Employees ROBERT L. HENDERSON, Brooklyn  
The Importance of Good Medical Staff Organization JOSEPH G. NICHOLS, Milwaukee  
Hospital Rate ALBERT H. SCHMIDT, Chicago

## PRELIMINARY CLINICAL PROGRAM

ARRANGED IN THE FOLLOWING SUBDIVISIONS: GENERAL SURGERY OBSTETRICS AND GYNECOLOGY,  
GENITO-URINARY SURGERY FRACTURES AND OTHER TRAUMAS, ORTHOPEDIC SURGERY THORACIC  
SURGERY NEUROSURGERY OPHTHALMOLOGY OTOLARYNGOLOGY

### GENERAL SURGERY

#### Monday

##### CHICAGO MEMORIAL HOSPITAL

PETER S. CLARK, CHARLES J. DEUCE, ROBERT A.  
MELROY, BENJAMIN R. PARKER, JOHN VAN PROHAKA,  
M. L. WEINSTEIN, LEO M. ZUCKERMAN and GEORGE  
M. LARD —1. Operative and dry clinic:  
JOHN VAN PROHAKA. Surgical aspects of carcinoma  
of the ampulla of Vater enterogenous cysts in  
infants.  
M. L. WEINSTEIN. Resection of stomach. 1th DePute  
instrument, rectal anesthesia.  
LEO M. ZUCKERMAN. Essential problems in the sur-  
gical treatment of inguinal hernia.  
BENJAMIN R. PARKER. Problems in gall-bladder sur-  
gery.

##### COOK COUNTY HOSPITAL

Staff— Symposium on biliary tract diseases  
EDWARD F. FOLLEY. Medical aspects.  
HARRY L. POPPER. Perverted physiology.  
FREDERICK STEIGELER. Jaundice.  
HARRY C. TIL. Urological factors in differential diag-  
nosis.  
WALTER SCHILLER. Pathology.  
M. J. HOWART. Roentgenological aspects in diagnosis.  
LEONARD SEED. Clinical results with synthetic Vitamin  
K in jaundice.  
RAYMOND W. MCNEAL. Pre- and postoperative man-  
agement.  
KARL A. MEYER. Operative management.  
MARSHALL D. TROY. Post-cholecystectomy pain.

##### Scientific Exhibit

Presented by following departments: Pathology, roent-  
genology, neurosurgery, blood bank, solutions labora-  
tory, medical record library, therapeutics, and the Cook  
County Graduate School of Medicine.

##### MICHAEL REESE HOSPITAL

Staff— Symposium on transfusion and infusions  
LEO M. ZUCKERMAN. History of blood transfusion.  
SERVEY O. LEVINSKY. General survey of modern  
transfusion department.  
HAROLD LAUFMAN. Blood transfusion reactions, statis-  
tical study.  
ANN MARIE STRAUSS. Experiences. 1th indirect trans-  
fusion reactions.  
HUTCHINSON A. CHILLES. Plasma and serum as substitutes  
for whole blood transfusions, physiology and labora-  
tory experiments.  
FRANK E. RUBINOWITZ. Clinical experience. 1th plasma  
and serum transfusions.  
Inspection of transfusion and serum departments.

RESEARCH AND EDUCATIONAL HOSPITALS  
Scientific Exhibit—Cancer of the large bow and appendicitis.

#### Tuesday

##### AUGUSTANA HOSPITAL

NELSON M. PERRY and OSCAR E. NADLON—9. Operative  
and dry clinics.

##### ALBERT MERRITT BILLINGS HOSPITAL

L. R. DRACOSTEY—9. Surgery of the colon.  
HILMER P. JENNINGS—9. Plastic surgery of the face, ears  
and operations.

##### COOK COUNTY HOSPITAL

KARL A. MEYER—9. Operative clinic. Stomach and colon.  
JOHN R. HANCOCK—9. Operative clinic. Peritoneal anes-  
thesia for major operations.  
C. C. GOTT—9. Surgical problems in the diabetic.  
SCOTT L. KOOCH—9. Dry clinic. Injuries and infections  
of the hand.  
RAYMOND W. MCNEAL—9. Operative clinic. Gall-  
bladder, gastric surgery.  
E. M. MILLER—9. Dry clinic. Bowel obstruction in the  
new born, gangrene complicating scarlet fever, volvulus  
of sigmoid colon in children.  
J. D. KOOCH—9. Operative and dry clinics. Arterio-  
sclerotic gangrene of the legs.  
JOHN B. O'DONOGHUE—9. Operative clinic. Gastro-  
intestinal.

##### Scientific Exhibit

Presented by following departments: Pathology, roent-  
genology, neurosurgery, blood bank, solutions labora-  
tory, medical record library, therapeutics, and the Cook  
County Graduate School of Medicine.

##### COOK COUNTY GRADUATE SCHOOL OF MEDICINE

Staff— Demonstration on cadaver, some principles in  
gall-bladder surgery.

##### EVANGELICAL HOSPITAL

P. E. HOPKINS, G. E. JOHNSON, and JAMES PATRICK—9.  
Operations.

##### EVANSTON HOSPITAL

W. R. PARKER, FREDERICK CHRISTOPHER, W. KENNETH  
JENNINGS, J. PETERMANN, NICHOLSON, J. VAN P. GELER,  
E. KRAMER, and FREDERICK WILLIAM MERRITT—9.  
Operative and dry clinic.  
FREDERICK CHRISTOPHER. Abdominal-peritoneal reser-  
vation for carcinoma of the rectum.  
W. KENNETH JENNINGS. The colonostomy.

JAMES P GRIER. Surgery of the biliary tract.  
 J L KEARNS Vascular clinic  
 J PEERMAN NESSELROD Motion pictures of the rectum  
 FREDERICK W MERRIFIELD Oral surgery

## GRANT HOSPITAL

KARL A MEYER—9 Operations  
 A G ZIMMERMAN—9 Mediastinal tumors

## MICHAEL REESE HOSPITAL

Staff—9 Operative clinic  
 JAMES PATEJDL Gastro-intestinal  
 R B BETTMAN and WILLIAM TANNENBAUM Gall bladder  
 A A STRAUSS and S F STRAUSS Stomach and colon  
 S L GOLDBERG General surgery  
 Staff—9 Dry clinic Symposium on peptic ulcer  
 HEINRICH NECHELES Newer conceptions of the physiology of stomach in relation to ulcer  
 JACOB MEYER The bleeding ulcer  
 H F BINSWANGER Treatment of bleeding ulcer with colloidal preparations  
 S F STRAUSS Indications for gastric surgery  
 A A STRAUSS Subtotal gastric resection  
 JAMES PATEJDL New methods in gastric surgery  
 Staff—2 Dry clinic  
 LEO M ZIMMERMAN Anatomy of inguinal hernia in relation to surgery  
 NATHAN N CROHN Incidence of strangulation in inguinal hernia, treatment of hernia  
 LEO M ZIMMERMAN and HAROLD LAUFMAN Unusual complications of inguinal hernia  
 R B BETTMAN and WILLIAM TANNENBAUM Wound evisceration  
 S L GOLDBERG Septicemia  
 D C STRAUSS Epiphyseal separations  
 Staff—2 Dry clinic Peripheral vascular surgery  
 LEO M ZIMMERMAN and S MUSCOVITZ Thrombophlebitis and pulmonary embolism  
 H. A. ROTH Indications and technique of saphenous vein ligation  
 SAMUEL PERLOW and S S HALPERN Prostigmin in peripheral vascular disease  
 SAMUEL PERLOW Injection treatment of angina pectoris, sympathectomy for peripheral vascular disturbances  
 S STAGMAN and E BLUMENTHAL Treatment of varicose veins in the aged  
 SAMUEL PERLOW and E BLUMENTHAL Ligation of the lesser saphenous vein

## MUNICIPAL TUBERCULOSIS SANITARIUM

CLEMENT L MARTIN—9 Anorectal tuberculosis

## RAVENSWOOD HOSPITAL

Staff—9 Operations  
 Staff—10 Tumor clinic Scientific exhibit, demonstration of procedure  
 Staff—10 End results of varicose vein operations

## RESEARCH AND EDUCATIONAL HOSPITALS

GÉZA DE TAKATS, J T REYNOLDS and staff—9 Operative clinic and symposium on hypertension Splanchnic nerve section for hypertension  
 S R ROSENTHAL Renal biopsies  
 F K HICK Physiology of the heart in hypertension  
 H C LUETH The kidney function in hypertensive states  
 H. E. HEYER The brain in hypertensive states

R O RISER. The eye grounds in hypertension—illustrated by Kodachrome slides  
 GÉZA DE TAKATS and associates The surgical approach to the problem of hypertension

## Scientific Exhibit

Cancer of the large bowel and appendicitis

## ST JOSEPH HOSPITAL

Staff—9 Operative and dry clinics  
 HUGH MCKENNA Cholecystectomy, thyroidectomy, closure of colon following second stage miculiz operation for carcinoma of descending colon  
 WILLIAM BECK. Acute intestinal obstruction  
 B J FITZGERALD Thyroidectomy  
 LEONARD KRATZ Ruptured appendicitis  
 FRANK MCCARTY Thyroidectomy, cholecystectomy, stomach surgery, gall bladder disease  
 J A WIMBERLY Thyroidectomy  
 STEPHEN A ZEIMAN Herniotomy, moving pictures of hernia operation

## ST LUKE'S HOSPITAL

W R CUBBINS—9 Operations  
 SELIM W MCARTHUR—9 Operations  
 Staff—9 Dry clinic  
 E C HOLMBLAD and R A JACOBSON Treatment of gas gangrene  
 T L HANSEN and J M L JENSEN Shelf fractures of tibia.  
 JOHN D ELLIS Amputations  
 JOHN L LINDQUIST Physiological problems and management in postoperative gastro-intestinal constant suction drainage  
 G V PONTIUS Hypertrophic pyloric stenosis in the adult  
 H I MEYER Paget's disease, osteitis deformans  
 W R CUBBINS Combined abdominal and chest injuries with differential diagnosis  
 ERIC OLDBERG Spinal injuries  
 ALFRED P SOLOMON Personality disorders during retarded convalescence following industrial injuries  
 H E Mock and associates—9 Skull fracture exhibit.  
 PAUL W GREELEY—10 Operations Total reconstruction of external ear, rhinoplasty

## WESLEY MEMORIAL HOSPITAL

RAYMOND W MCNEALY—9 Thyroidectomy, resection of colon  
 S J FOGELSON—9 Gastric resection  
 WILLIAM M McMILLAN—9 Repair of inguinal hernia  
 JOSEPH E SCHAEFER and KENNETH W PENHALE—9 Repair of cleft palate  
 WILLIAM A HENDRICKS—9 Demonstrations Lymphosarcoma of the stomach, stab wound of the heart with repair, isolated simple non specific ulcer of the cecum, healing without surgery  
 GUY S VAN ALSTYNE—9 Demonstration Common duct stone with rupture of common duct  
 EARL O LATIMER—10 Gastric resection  
 WILLIAM MILLER—10 Cholecystectomy  
 NORMAN G PARRY—10 Cholecystectomy

## Wednesday

## AUGUSTANA HOSPITAL

A T LUNDGREN and EARL GARSIDE—9 Operative and dry clinic  
 JOHN W NUZUM and RUDOLPH ODEN—9 Operative and dry clinic

## CHICAGO MEMORIAL HOSPITAL

Medical, surgical, x-ray and pathological departments—  
Symptoms. Treatment of pneumonia. Hb serum and  
sulphapyridine peptic ulcer.

## CHILDREN'S MEMORIAL HOSPITAL

ALBERT H. MONTGOMERY, JOHN A. GRUBER, J. REELAND,  
W. J. POTTS, J. J. MURPHY, A. E. DRUGA, and S. E.  
LAWTON—g. Operations

## COOK COUNTY HOSPITAL

VICTOR L. SCHLAGER—g. Operations.  
RALPH C. SULLIVAN—g. Operations.  
EDWARD A. CHRISTOPHERSON—g. Operative clinic. Ap-  
pendicitis.

FRANK J. JIRKA—o. Dry clinic. Dyspepsia in the  
male.

J. R. BRECHENBERG—i. Operative clinic. Thyroid, biliary  
tract.

## Scientific Exhibit

Presented by following departments: Pathology, roentgen-  
ology, neurosurgery, blood bank, solutions laboratory,  
medical record library, therapeutics, and the Cook  
County Graduate School of Medicine.

## COOK COUNTY GRADUATE SCHOOL OF MEDICINE

Staff— Demonstrations on cadaver and anesthetized  
dog. Gastric surgery

## HENROTIN HOSPITAL

ROBERT F. SIKES—g. Operative and dry clinic. Gastro-  
jejunal ulcer.

## JACKSON PARK HOSPITAL

C. C. CLARK—g. Abdominal operations.  
A. BARNHARTER—ro. Abdominal and thyroid operations.  
H. H. COY— Operative and dry clinic

## LORETTO HOSPITAL

E. PERRY V. DODD—g. Operations.  
ALLEN E. STEWART and L. B. NEWHA— Operative  
and dry clinic.  
FRANK M. SYLVESTER—g. Operations.  
LOUIS F. PLEAK and FRANK F. KOTLIK— Gallbladder clinic.

## MERCY HOSPITAL

M. F. MCCOY—g. Operative and dry clinic. Biliary  
tract.  
WILLIAM J. PICKETT—g. Operative and dry clinic. Gas-  
tric surgery.  
C. F. SAUER—g. Intestinal obstruction.  
J. SANDROV—g. Tests for liver function

## MICHAEL REESE HOSPITAL

Staff—g. Operative clinic.  
M. L. PARKER. Thyroid.  
A. A. STRAUSS and S. F. STRAUSS. Gastro-intestinal.  
R. B. BETTMAN and WILLIAM T. VERBAUGH. Surgery of  
extra hepatic bile tracts.  
NATHAN V. CHERRY. Subject to be announced.  
LE. M. ZIMMERMAN. Hernia.

Staff—g. Dry clinic. Symposium on diseases of the bile  
tracts

HENDRICK NACHELS. New knowledge of physiology of  
the gall-bladder

S. A. PORTER. Medical indications for surgery of the  
gall-bladder

R. B. BETTMAN. Techniques of gall bladder operations  
with motion pictures.

A. M. SPERRY. Liver function tests.

WILLIAM T. VERBAUGH. Carcinoma of the gall bladder.

C. M. LUCIUS. X-ray. End results of gall bladder surgery.

N. TH. V. CHERRY. Measurements of the common and  
cystic ducts.

ROBERT ARFVER and R. B. BETTMAN. Immediate chole-  
angiography

Staff—g. Dry clinic.

LEON BLOCK. Ulcerative colitis.

A. A. STRAUSS. Indications for ileostomy in colitis  
surgery

S. F. STRAUSS. Surgical lesions of the colon.

ROBERT ARFVER. X-ray diagnosis of diseases of the  
colon

OTTO SAPHIR. Pathology of the colon

HENDRICK NACHELS. Newer physiology of the in-  
testines.

## MOTHER CARRINI MEMORIAL HOSPITAL

F. J. CHESNOW and associates—g. Abdominal operations.

## PASSAVANT MEMORIAL HOSPITAL

SCHERER L. KOCH, MICHAEL L. MAISON, and HARVEY ALLEN  
—g. Dry clinic. Presentation of cases illustrating prob-  
lems in surgery of the hand, discussion of wound in-  
fections

## RESEARCH AND EDUCATIONAL HOSPITALS

WARREN H. COLE and staff—g. Operative clinic and thy-  
roid symposium. Thyroidectomy preoperative for  
thyroidectomy

R. B. MALCOLM. Serological pathology of goiter

J. T. REYNOLDS. Postoperative treatment.

CHARLES B. PETERSON. Suture material and end results.

LONDON SUTER. Ring operation for recurrent nerve  
paralysis.

R. W. ARISTON. Management of patients with hyper-  
thyroidism and cardiac disease

P. W. GREENLEY—g. Thick rubber graft; artificial con-  
struction. Island artery flap; more costal cartilage  
graft to nose. Full thickness skin graft to hand, dem-  
onstration of plastic cases.

P. J. SARRIS—g. 30. Vascular clinic.

WARREN H. COLE—75. Splenectomy

## Scientific Exhibit

Cancer of the large bowel and appendicitis

## ST. ANNE'S HOSPITAL

G. F. THOMPSON, J. J. GRANT, J. L. KRAFF, J. W. KEANE

ADOLPH KRAFF and H. M. PETERSON—g. Operations

ADOLPH KRAFF— Dry clinic. Carcinoma of cervix.

G. F. THOMPSON— Dry clinic. Carcinoma of breast,  
blastomycosis of cervix

## ST. BERNARD'S HOSPITAL

WILLIAM G. EPPSTEIN—g. Thyroid operations.

L. B. DOWLING, C. M. LAMARCA, and WILLIAM M. LON-  
GAST—g. Abdominal operations

S. L. GONZALEZ—g. Dry clinic. Pseudohypertrophic mus-  
cular dystrophy

## ST. LUKE'S HOSPITAL

H. E. MOCK—g. Operations

Staff—g. Dry clinic

SELDEN W. MCARTHUR. Stomach deformities simulating  
pregnancy in x-ray study.

H. E. MCNEILL. Lesions of the colon.

F. E. JONES. Treatment of complete biliary fistula.

E. LEE STROHL. Common duct obstructions

W G DIFFENBAUGH Autoplasty operation for hernia repair, statistical report.

H E MOCK Breast tumors, malignancies and granulomas of the gastro-intestinal tract.

E W RYERSON Conservative treatment of fractures

T P GRAUER. Injuries of the genito-urinary tract.

HAROLD A. SOFIELD Fractures of femoral neck

H E MOCK and associates—9 Skull fracture exhibit

#### SWEDISH COVENANT HOSPITAL

R F ELMER, W B STROMBERG, and A C PETERSON—9 Operative clinic Surgery of stomach and gall tracts

K L VEHE, A P SANDAHL, and R E TALBOTT—9 Head and neck infections, anatomical demonstrations

M R BROMAN—9 Problems in pathology in a private hospital

R G WILLY—9 Diagnostic problems studied in a private hospital

#### VETERANS ADMINISTRATION FACILITY

P F BROWN and B F WARD—9 Abdominal operations

R B MORELAND—9 Operative clinic Tumors

A. E. WILLIAMS—9 Inspection tour of deep x-ray and radium unit.

G R ALLABEN—10 Dry clinic Tumor clinic in the general hospital, method of presentation of cases before Tumor Board, diagnosis, treatment, and follow up

MAX CUTLER—11 Dry clinic Carcinoma of the mouth and larynx, problems in diagnosis and treatment, indications for surgery and irradiation in laryngeal carcinoma, presentation of cases

#### Thursday

#### ALEXIAN BROTHERS' HOSPITAL

WILLIAM J SWIFT—9 Herniotomy

DANIEL E MURPHY—9 Circulatory disturbances of lower extremity

FREDERICK A RETTIG—10 Abdominal surgery and post-operative care

#### AUGUSTANA HOSPITAL

NELSON M PERCY and OSCAR E NADEAU—9 Operative and dry clinics Symposium on diagnosis and surgery of goiter

#### CHICAGO MEMORIAL HOSPITAL

CASPER M EPSTEIN—9 Operative clinic Correction of cleft palate, facial plastic

#### CHILDREN'S MEMORIAL HOSPITAL

ALBERT H MONTGOMERY, JAY IRELAND, and J J MUSSIL—2 30 Demonstration of cases Abdominal tumors in children, subphrenic abscess, osteomyelitis, retroperitoneal tumors

#### COLUMBUS HOSPITAL

DANIEL A ORTH—9 Operations

H E DAVIS—9 Selective radiation therapy of malignancies, presentation of cases

R J MURPHY—9 Operations

ERNEST NORA—9 Demonstration Stethocardiograph as an aid in surgical diseases

H R KENNY—10 Crohn's disease, presentation of cases

#### COOK COUNTY HOSPITAL

RALPH C SULLIVAN—9 Operative clinic

MARSHALL DAVISON—10 Operative clinic Thyroid

R B BETTMAN—2 Operative clinic.

#### Scientific Exhibit

Presented by following departments Pathology, roentgenology, neurosurgery, blood bank, solutions laboratory, medical record library, therapeutics, and the Cook County Graduate School of Medicine

#### COOK COUNTY GRADUATE SCHOOL OF MEDICINE

RAYMOND W MCNEALY—11 Lecture Femoral hernia  
Staff—1 Demonstration on cadaver Surgery of the large bowel

#### EVANGELICAL HOSPITAL

P E HOPKINS, G E JOHNSON, and JAMES PATEJDL—9 Operations

#### HOLY CROSS HOSPITAL

V T TORCZYNSKI Blood pressure and spinal anesthesia—study of 100 cases

J B KARR. Injection treatment of hernia, herniotomy

F T FRAIDER and N B PAVLETIC Indirect inguinal hernia

F J SALETTA Thyroidectomy

M J BADZMIEROWSKI Thyroidectomy

J F RUZIC and D S DICIRO Hernioplasty, vaginal hysterectomies, cholecystectomy, common duct exploration, thyroidectomy

#### ILLINOIS MASONIC HOSPITAL

WILBUR E KEESEY and J WALTER JOHNSON—9 Cholecystectomy

R BRUCE MALCOLM—9 Partial gastrectomy

JOHN R HARGER and JOHN PISHOTTA—9 Cholecystoduodenostomy

C DRUECK, Sr. and HENRY E OLIVER—9 Hemorrhoidectomy

W C BORNEMEIER and I KROSS—10 Herniotomy

T G WALLIN and BEULAH WALLIN—10 Amputation of breast

WARREN PUGH—10 Resection of colon

JOHN F DAVIS and A E WUESTEMAN—11 Colostomy

PAUL MORF and EDWARD LEVISOHN—11 Appendectomy

W B GERHARD and GEORGE GEYMER—11 Amputation of breast

#### MERCY HOSPITAL

L D MOORHEAD—9 Operative and dry clinic Thyroid

A K VAUGHN—9 Treatment of varicose veins and ulcers

#### MICHAEL REESE HOSPITAL

Staff—9 Operative clinic

A A STRAUSS and S F STRAUSS Gastro-intestinal

M L PARKER Subject to be announced

JAMES PATEJDL. Stomach and colon

S L GOLDBERG Subject to be announced

SAMUEL PERLOW Peripheral vascular surgery

Staff—9 Dry clinic Thyroid symposium.

S SOSKIN Physiological disturbances in thyrotoxicosis  
ROBERT C LEVY Special tests in diagnosis of borderline thyroid cases

OTTO SAPHIR and LEO M ZIMMERMAN Neoplasms of the thyroid

M L PARKER and H A ROTH Analysis of five years' thyroid surgery and follow up

A K KOFF Menstrual disturbances in relation to thyroid diseases

Staff—2 Dry clinic

S L GOLDBERG Fish bone perforation of ileum

M L PARKER Periarthritis nodosa of bowel, foreign bodies in the stomach, regional ileitis

- R. B. BETTMAN and WILLIAM T. VAENBAUM. Foreign body perforation of the intestinal tract: complications of gastro-enterostomy.  
S. L. GOLDBERG and L. N. KATZ. Attempts at reducing experimental hypertension in dogs.

## MUNICIPAL TUBERCULOSIS SANTARIUM

- R. M. D. VISION—*g*. Surgical treatment of tuberculosis.

## NORWEGIAN AMERICAN HOSPITAL

- J. M. ANDERSON—*g*. Intravenous medication.  
O. B. F. ULST—*g*. *g*. Surgical physiology of the thyroid.  
A. M. JENSEN—*g*. *g*. Sulfanilamide in general surgery.  
J. R. OGDEN—*g*. Technique of thyroidectomy.  
T. H. FOWLER—*g*. Time question in appendicitis.  
J. V. FOWLER, JR.—*g*. Pre and postoperative care of the thyroid patient.  
J. E. VIGLUND—*g*. Hernia from industrial causes.  
M. M. CORRETT—*g*. Immediate treatment of abdominal injuries.  
WARREN JOHNSON—*g*. Carcinoma of the stomach.  
F. M. NICHOLSON—*g*. Treatment of scalp injuries.  
M. E. LICHTENSTEIN—*g*. Technique of cholecystectomy.  
J. V. FOWLER, SR.—*g*. Carcinoma of the breast.

## PASSAVANT MEMORIAL HOSPITAL

- JOHN A. WOLFE and associates—*g*. Tumor clinic.  
FRANK QUINN. The surgeon and pathologist as diagnostic team, I: the decision for and conduct of biopsy with illustrative cases.  
EARL E. BARTZ. Important preliminaries prior to x-ray therapy.  
H. E. D. —*g*. Selection of tumor cases and x-ray vs. radium therapy.  
H. L. JUFFE. Administration of radiation therapy for malignant tumors.  
F. W. MERRIFIELD. Our results with intra-oral tumors.  
J. M. GREENE. Useful aids in differential diagnosis of tumors of the neck.  
JOHN A. WOLFE. Our results with cancer of the breast.  
E. M. BARTZ, J. Results with treatment of unusual cutaneous tumors.  
HERMAN CHOW. The psychiatrist part in tumor clinic illustrations, cases.  
EARL E. BARTZ. Inspection of radiation therapy department of Northwestern University Medical School.

## PRESBYTERIAN HOSPITAL

- KELLOGG SPEED, CARL B. D. JR., ALBERT H. MOIST, OSWEN EDWIN M. MILLER, F. ANDERSON JR., HARRY OVERHELMAN, W. J. POTTS, HILLIER BAKER, F. M. V. THOMAS, ROBERT H. FELL, R. K. GILCHRIST and VERNON C. D. VID—*g*. Operations.

## RESEARCH AND EDUCATIONAL HOSPITALS

- CHARLES B. PETERSON and staff—*g*. Operative and dry clinic.  
CHARLES B. PETERSON. Choledochostomy for stone physiology of the common duct as related to surgery.  
E. F. JOLLY. The jaundiced patient from the medical viewpoint.  
WARREN H. COLE. Lessons of the cystic duct as related to gall bladder disease.  
LUDWIG SEID and J. KARBYN. Use of V. LARSEN K. in hypophosphoribosidemia.  
CHARLES B. PETERSON. Excision carcinoma of colon.  
Scientific Exhibit.  
Cancer of the large bowel and appendix.

## ST LUKE'S HOSPITAL

- GÉA DE TAKATS and J. T. RAYNOLD—*g*. Operative clinic. Lumbar sympathectomy.  
P. UL. W. GIBELLY—*g*. Operations. Construction of new eyebrows; full thickness skin graft; split skin graft.  
H. E. MOCK and associates—*g*. Skull fracture exhibit.  
JOHN S. COULDER—*g*. Physical therapy in peripheral vascular disease.  
O. K. FINCH—*g*. Extracardiac factors influencing coronary circulation.  
O. W. SCOTTHAM—*g*. Renal disease and hypertension.  
R. B. CARP—*g*. Vascular reflexes during operations.  
J. M. L. JENSEN—*g*. Paravertebral block of the sympathectomy technique and indications.  
GÉA DE TAKATS—*g*. Demonstration in vascular surgery. Cervical rib and aneurysm. Aired aneurysm of aorta, congenital arteriovenous fistula of the head, modified Koonelson operation of thromboplastic endocarditis.

## ST MARY OF NAZARETH HOSPITAL

- T. M. LARROW—*g*. Operative clinic.  
E. H. WARRINGTON—*g*. Operative clinic.  
THOMAS STEVENS—*g*. Operative clinic.  
O. M. MILLER—*g*. Operative clinic.

## Friday

## ALBERT MERRITT BILLINGS HOSPITAL

- ALEXANDER B. FENICHA—*g*. Operative clinic. Tumors of the adrenal gland.

## CHILDREN'S MEMORIAL HOSPITAL

- LOUIS B. SCULLY—*g*. Operative clinic and demonstration of cases. Oral surgery.

## COOK COUNTY HOSPITAL

- LOUIS RIVER—*g*. Dry clinic. Abdominal lactation.  
E. H. WARRINGTON—*g*. Operative clinic. Reconstruction treatment of burns.  
J. R. BRECHINGER—*g*. Operative clinic. Gastric resection for duodenal ulcer.

## Scientific Exhibit

- Presented by following departments. Pathology, roentgenology, neurosurgery, blood bank, radiations laboratory, medical record library, therapeutics, and the Cook County Graduate School of Medicine.

## MICHAEL REESE HOSPITAL

- JAMES P. REESE, A. A. STRACHAN, E. F. STRACHAN, M. L. PARKER, NATHAN CROWN, & L. GOLDBERG, LEO M. ZIEGLERMAN and SAMUEL PERLOW—*g*. Operations.

## MT SINAI HOSPITAL

- D. A. WILSON—*g*. New type of hernioplasty.  
E. I. GREEN—*g*. Operative clinic.  
V. L. SCHWARTZ and staff—*g*. Hernioplasty.  
A. A. STRACHAN and S. F. STRACHAN—*g*. Surgery of the colon.  
M. R. G. TIT—*g*. Plastic surgery of the nose.  
JACOB LITVIN—*g*. Endoscopy.  
E. H. ALON—*g*. Oral surgery.  
J. M. MORRIS—*g*. Thyroidectomy.

## PASSAVANT MEMORIAL HOSPITAL

- J. R. BRECHINGER—*g*. Dry clinic. Illustrations of end results in treatment of gastric and duodenal ulcers.

**PRESBYTERIAN HOSPITAL**

FREDERICK B MOOREHEAD—9 Plastic surgery

**RESEARCH AND EDUCATIONAL HOSPITALS**

R B MALCOLM and staff—9 Operative and dry clinic  
R B MALCOLM Radical resection for carcinoma of breast, surgical pathology of breast tumors, excision of branchial cleft cyst  
P J SARMA Differential diagnosis of breast lesions  
T J WACHOWSKI Radiation therapy of carcinoma of breast  
GEORGE DE TARNOWSKI End results in carcinoma of breast.

P W GREELEY—10 Plastic surgery, follow up clinic  
Scientific Exhibit

Cancer of the large bowel and appendicitis

**ST ELIZABETH'S HOSPITAL**

Staff—9 Operative and dry clinics  
M G LUKEH Hernia operations

A G ZIMMERMAN Thyroidectomy, treatise on pathology of the thyroid gland  
E B KALVELAGE Surgery of the stomach  
Staff—1 Operative and dry clinics  
J B O'DONOVUE Complications in surgery of the gall bladder and ducts  
J P WOITALEWICZ Intestinal surgery

**ST LUK'S HOSPITAL**

H E MOCK and associates—9 Skull fracture exhibit

*Days to be Announced*

**HOSPITAL OF ST ANTHONY DL PADUA**

F B OLENTINE and M J BAZMILROWSKI Thyroid operations  
J J SPRAFKA Abdominal operations  
S E DONLON, H P SULLIVAN, FRID LURMANN, W H BRADLEY, JOSEPH ZABOKRTSKY, and R C DRURY Operative and dry clinic  
FRANK J JIRKA Lecture Convulsions under anesthesia

**OBSTETRICS AND GYNECOLOGY**

*Monday*

**COOK COUNTY HOSPITAL**

A J KOBAK and H H HILL—2 Studies in acriflavine and glycerine  
JAMES H BLOOMFIELD—2 Demonstration of cases Cesarean section and local anesthesia, management of occiput posterior  
S J BENENSON—2 Lues in the prenatal clinic  
T J MORRIS—2 Puerperal infection

**RESEARCH AND EDUCATIONAL HOSPITALS**

Scientific Exhibit

Essentials of prenatal care, puerperal sepsis, care of the premature infant, ectopic pregnancies

*Tuesday*

**CHICAGO LYING IN HOSPITAL**

FRED L ADAIR, WILLIAM J DIECKMANN, M EDWARD DAVIS, H CLOSE HESSELTINE, and FRANKLIN T SNYDER—9 Operations  
FRED L ADAIR and staff—2 Dry clinic  
FRED L ADAIR Subject to be announced  
FREDERICK W SCHULTZ Management of birth trauma  
WILLIAM J DIECKMANN Treatment of the toxemias of pregnancy  
M EDWARD DAVIS Treatment of placenta previa  
GORDON T BURNS Treatment of abruptio placentae  
EDITH L POTTER A review of the post mortem findings in 2,000 fetal and neonatal deaths  
CHARLOTTE L CLANCY Problems in the control of reproduction

**COOK COUNTY HOSPITAL**

W T CARLISLE—9 Gynecological operations  
A C KANTER—10 Gynecological operations

**EVANSTON HOSPITAL**

W C DANFORTH, R M GRIER, HOWARD J HOLLOWAY, P H SMITH, and C E GALLOWAY—9 Operative clinic Vaginal hysterectomy, abdominal hysterectomy

**MERCY HOSPITAL**

HERBERT L SCHMITZ and staff—9 Operative and dry clinic Vaginal hysterectomy, Watkins transposition operation, Manchester Mather operation for vaginal plastic, anterior colporrhaphy and perineorrhaphy, 1e 1ort colpocleisis  
Staff—2 Demonstrations and discussions of obstetrical problems

**MICHAEL REESE HOSPITAL**

J L BAER—9 Operation Radical hysterectomy  
J E LACKNER—9 Operation Total abdominal hysterectomy  
L E FRANKENTHAL—9 Operation Cesarean section

**PASSAVANT MEMORIAL HOSPITAL**

ARTHUR H CURTIS and GEORGE H GARDNER—9 Operative and dry clinic Integration of newer anatomical studies with clinical gynecology

**RAVENSWOOD HOSPITAL**

Staff—10 Demonstration of cases

**RESEARCH AND EDUCATIONAL HOSPITALS**

Scientific Exhibit

Essentials of prenatal care, puerperal sepsis, care of the premature infant, ectopic pregnancies

**ST JOSEPH HOSPITAL**

CLYDE J GEIGER—9 Operation for carcinoma of the cervix

**ST MARY OF NAZARETH HOSPITAL**

M E UZNANSKI—10 Operations  
A S SAMPOLINSKI—11 Vaginal hysterectomy

**WESLEY MEMORIAL HOSPITAL**

MARK T GOLDSTONE and associates—9 Operative and dry clinic Gynecological  
WILLIAM B SERBIN—9 Operative and dry clinic Obstetrical



GAR OOD C. RICHARDSON— Operative and dry clinic  
Obstetrical.

### Wednesday

#### CHICAGO LYING-IN HOSPITAL

FRED L. ADAMS, WILLIAM J. DICICMAN, M. EDWARD D. IV, H. CLODE HEMSELITZ, and FRANKLIN F. SYDNER— Operations

FRED L. ADAMS and staff—1. Dry clinic  
H. CLODE HEMSELITZ. The use of sulfanilamide, sulfapyridine and sulfathiazole in obstetrics and gynecology

ROBERT G. BLOCK. Tuberculosis in pregnancy

FRANKLIN F. SYDNER. Treatment of epiphysal neostomium

HENRY T. RUCKETS. Diabetes in pregnancy

SCOTT L. WOLTERS. Treatment of carcinoma of the uterus

JOSEPH H. MORTON. Clinical studies in uterine motility

RUTH WATTS. Studies of ovarian tumors

#### CHICAGO MEMORIAL HOSPITAL

HARRIET B. W. BENJAMIN, JAMES E. FITZGERALD, WILLIAM F. HEWITT, GEORGE N. SCHIFF, BEATRICE E. TUCKER, and HARRY L. MEYERS— Operations and dry clinic

HARRIET B. W. BENJAMIN. Perineal block in obstetrics

GEORGE N. SCHIFF. Obstetrical analgesia

JAMES E. FITZGERALD. Effect of Vitamin K in labor

BEATRICE E. TUCKER and HARRY L. MEYERS. Manchester anterior colporrhaphy and perineorrhaphy

#### COOK COUNTY HOSPITAL

HERBERT E. SCHMIDT— Gynecological operations

A. F. LAURE— Gynecological operations

#### EVANGELICAL HOSPITAL

P. ARTHUR DELANEY and associates. Clinical pathological conference on unusual uterine pathology. Endometrial sarcoma malignancy (leiomyosarcoma) in uterine fibroids sarcoma botryoides, child 34 years old, adenocarcinoma uteri (Frankel) endometriosis, actinomycosis in ovaries, granulosa cell tumor of ovary (microscopic) carcinoma in cystic ovaries, carcinoma in solid ovaries, ectopic tubal pregnancy with tuberculous salpingitis

#### LORETTO HOSPITAL

HARVEY LITTLE and NICHOLAS BALZANO— Operative clinic Gynecological

#### MICHAEL REESE HOSPITAL

Staff— Dry clinic

A. F. LAURE. Early treatment of puerperal sepsis peritonitis

H. A. STRAUSS and S. D. MENDELSON. Ball method of cephalopelvicmetry

L. F. STEIN. Gynecography

M. R. COHEN. Clinical use of progesterone

FRANK RICHMOND. Serum therapy in shock or hemorrhage

E. J. DECOIT. Further development of the photostethoscope

J. E. LACKER and A. S. T. LEE. Effect of prephyria on the ovary

#### PRESBYTERIAN HOSPITAL

N. SPRADE HEARBY, ARNOLD KATZ, EDWARD C. ALLEY, A. H. KILWANE, FRED PRIEST and HARRY BOYCE— Operations Gynecological

#### RESEARCH AND EDUCATIONAL HOSPITALS

F. H. FALLS and staff—1. Operative and dry clinic

W. H. BROWN. Low cervical cerclage section

J. R. WOLFE. Six cases of early carcinoma of cervix uteri

R. A. LEVENDAREL. Vaginal hysterectomy for prolapsed uterus

F. H. FALLS. Vaginal hysterectomy for fibroids

H. H. HILL. Report of two cases of ovarian pregnancy

A. F. LAURE. Supercervical hysterectomy

#### Scientific Exhibit

Essentials of perinatal care: puerperal sepsis, care of the premature infant, ectopic pregnancies

#### ST ANNE'S HOSPITAL

J. L. FLEMING— Dry clinic: Hematogenous streptococcal puerperal infection, chorio-epithelioma of fallopian tube, inversion of uterus

R. J. HARRIS—1. Easestil delivery room equipment

#### SWEDISH COVENANT HOSPITAL

R. A. LEVENDAREL, G. F. HERRERT, G. L. ROSENE, and H. J. THORNDYKE— Vaginal hysterectomy cesarean section case studies

#### WASHINGTON BOULEVARD HOSPITAL

P. CL. C. FOX— Operative and dry clinic

#### WOMEN AND CHILDREN'S HOSPITAL

AMELIA GINDYOTAS, ELOISE PARSONS, PEARL STUEHL, MAM. EDWIN W. ELLIAMS, and MAUDE HALL WINTER—

Surgical and gynecological operations

BEATRICE T. CLEGG— Operations

BETTY VAN HOOZEN— Demonstration. Teaching gynecology by models

### Thursday

#### CHICAGO LYING-IN HOSPITAL

FRED L. ADAMS, WILLIAM J. DICICMAN, M. EDWARD D. IV, H. CLODE HEMSELITZ, and F. VELD F. SYDNER— Operations

FRED L. ADAMS and staff— Dry clinic

WILLIAM J. DICICMAN. Results of treatment of toxemia patients

M. EDWARD D. IV. Rational endocrine therapy in obstetrics and gynecology

ALLA T. KENYON. Metabolic influences of the steroid hormones

MELBOIRNE W. BOYNTON. Present-day management of the menopause

KATELIE KATO. Vitamin K deficiency in the newborn

ALICE CHILDS. Heart disease in pregnancy

DONALD M. SCHUTTKER. Subject to be announced

#### COLUMBUS HOSPITAL

CHARLES W. BARRETT— Operations

F. O. BOWE— Dry clinic

#### COOK COUNTY HOSPITAL

E. W. FINCHAM— Gynecological operations

J. P. G. EDWARDS— Gynecological operations

#### GRANT HOSPITAL

F. H. FALLS— Gynecological operation

E. W. FINCHAM— Gynecological operation

HOLY CROSS HOSPITAL

P E LAWLER. Manikin demonstration  
F F FRAIDER and N B PAVLETIC Hysterectomy  
F J SALETTA Hysterectomy

ILLINOIS MASONIC HOSPITAL

F O BOWE and PAULINE LANGE—9 Cesarean section  
DANIEL W JEFFRIES and R LEVISOHN—9 Ventral fixation of uterus  
HAROLD W MILLER and GLEN NELSON—10 Hysterectomy  
ALLAN H FERGUSON—10 Perineorrhaphy  
A J SCHOENBERG and M OWEN WILKINS—11 Amputation of cervix

NORWEGIAN AMERICAN HOSPITAL

B W BREISTER—9 Indications for cesarean section  
P F SNYDER—11 Differential diagnosis of uterine tumors

PASSAVANT MEMORIAL HOSPITAL

ARTHUR H CURTIS and GEORGE H GARDNER—9 Operative and dry clinic Vaginal plastic procedures and abdominal total hysterectomies  
DAVID S HILLIS and associates—2 Dry clinic Cephalopelvic disproportion

RESEARCH AND EDUCATIONAL HOSPITALS

Scientific Exhibit

Essentials of prenatal care, puerperal sepsis, care of the premature infant, ectopic pregnancies

ST LUKE'S HOSPITAL

Staff—10 Operations

*Friday*

CHICAGO LYING IN HOSPITAL

FRED L ADAIR, WILLIAM J DIECKMANN, M EDWARD DAVIS, H CLOSE HESSELTINE, and FRANKLIN F SNYDER—9 Operations  
FRED L ADAIR and staff—2 Dry clinic  
FRED L ADAIR Treatment of uterine prolapse  
FRANKLIN F SNYDER Subject to be announced  
H CLOSE HESSELTINE Management of chronic and resistant vaginal trichomoniasis  
HILGER P JENKINS Acute appendicitis of pregnancy  
LUCILE HAC Transportation of gonococcal cultural material  
PRICILLA OUDA Vomiting as a complication of obstetrical anesthesia

GENITO-URINARY SURGERY

*Tuesday*

EVANSTON HOSPITAL

JAMES I FARRELL—9 Infections of the urinary tract

MICHAEL REESE HOSPITAL

Staff—9 Dry clinic  
GUSTAV KOLISCHER Carcinoma of breast successfully treated with macrophages.  
IRVIN S KOLL Massive renal calculi  
HARRY C ROLNICK Radical perineal prostatectomy  
A E JONES Hydronephrosis due to retroperitoneal lymphosarcoma

COOK COUNTY HOSPITAL

WILLIAM H BROWNE—9 Gynecological operations  
F H FALLS—10 Gynecological operations  
AUGUST DARO Use of epinephrine in acute inversion of the uterus  
LOUIS RUDOLPH Ring dystocia constriction  
JAMES E FITZGERALD Heart disease in pregnancy  
DAVID S HILLIS Recognition of cephalopelvic disproportion  
AUGUSTA WEBSTER Vitamin K in pregnancy

MICHAEL REESE HOSPITAL

WILLIAM RUBOVITS—9 Neugebauer LeFort operation for prolapse  
RALPH A REIS—9 Vaginal hysterectomy  
I F STEIN—9 Bilateral ovarian resection  
M L LEVENTHAL—9 Manchester operation for prolapse of uterus

MT SINAI HOSPITAL

A E KANTER and LOUIS RUDOLPH Gynecological operations  
A F LASH Vaginal hysterectomy  
HENRY BUXBAUM, CHARLES NEWBURGER, and A H GOLDFINE Obstetrical clinic

RESEARCH AND EDUCATIONAL HOSPITALS

F H FALLS and staff—2 Operative and dry clinic  
G H REZEK Supracervical hysterectomy  
A J KOBAK Report of three cases of interstitial ectopic pregnancy  
W H BROWNE Vulvectomy  
R A LIFVENDAHL LeFort operation for prolapse of uterus  
V C FREDA Skin test for pregnancy  
F H FALLS Vaginal hysterectomy under local anesthesia

Scientific Exhibit

Essentials of prenatal care, puerperal sepsis, care of the premature infant, ectopic pregnancies

ST ELIZABETH'S HOSPITAL

B S MILTON—9 Hysterectomy for fibroid tumors, discussion of pathology of fibroid tumors  
J K NARAT—1 Tumors of the uterus  
J R LAVIERI and F J WALSH—3 Surgical complications in obstetrics

*Days to be Announced*

HOSPITAL OF ST ANTHONY DE PADUA

M A WEISSKOPF Obstetrical operations

IRVING SHAPIRO Ureteral injuries in gynecological operations  
FREDERICK LIEBERTHAL Tumors of kidney  
J S GROVE Ureteral calculus in case of solitary kidney, urosepsis

PRESBYTERIAN HOSPITAL

HERMAN L KRETSCHMER, ROBERT HERBST, NORRIS J HECKEL, and JAMES MERRICKS—9 Operative clinic and demonstration of cases

RAVENSWOOD HOSPITAL

Staff—10 Demonstration of cases

## ST JOSEPH HOSPITAL

Staff—g. Dry clinic.

## WESLEY MEMORIAL HOSPITAL

VICTOR D. LEIBERMAN—g. Operative and dry clinic.  
DONALD K. HENSE—ro. Operative and dry clinic.

## Wednesday

## ALBERT MERRITT BILLINGS HOSPITAL

CHARLES B. HUGGINS—g. Operations.

## HENROTIN HOSPITAL

C. O. MILLER—g. Neoplasms of the kidneys.

## LORETTO HOSPITAL

CARL J. UTHOFF—g. Operative and dry clinic.

## MERCY HOSPITAL

H. E. LAWRENCE—g. Clinical cytometry as aid in the diagnosis of disturbances of micturition.

## MICHAEL REESE HOSPITAL

GUYA KOLBACHER, I. S. KOLL, J. S. EISENSTADT, H. C. ROSENICK, A. E. JONES, I. J. SHAPIRO, F. LEIBERSTEIN, and J. S. GROVE—g. Operations.

## MUNICIPAL TUBERCULOSIS SANITARIUM

D. F. REDNICK—g. Genito-urinary tuberculosis.

## ST ANNE'S HOSPITAL

H. J. DOOLEY and C. C. SALLER—g. Operations.  
H. J. DOOLEY—Assestments in genito-urinary surgery.  
C. C. SALLER—Surgery of prostate in diabetes, discussion and demonstration.

## ST BERNARD'S HOSPITAL

A. J. SULLIVAN—g. Prostatic operations.

## SWEDISH COVENANT HOSPITAL

B. E. FILLIS, J. T. GILSON and R. D. KOKLSTEDT—g. Genito-urinary problems.

## VETERANS ADMINISTRATION FACILITY

T. G. McDONNALL—g. Operations.

## Thursday

## ALEXIAN BROTHERS' HOSPITAL

JOSEPH M. GLASSER—g. Prostatectomy cases.  
LOWEN F. HENSE—g. Dry clinic. Nephrotomy, cystoscopy and pyelography.  
EDWARD W. WHITE—g. Prostatic electroresection, ureteral stone.  
A. J. WOODWARD—ro. Prostatic electroresection, fulguration of bladder tumor cases.

## CHICAGO MEMORIAL HOSPITAL

VICTOR J. O'CONNOR, JOHN F. O'NEIL, J. WILLIAM PARKER, and KENNETH SOKOL—g. Operative and dry clinic.

## CHILDREN'S MEMORIAL HOSPITAL

HERMAN L. KRETSCHMER—g. Operative clinic and demonstrations. Urological problems in infancy and childhood.

## COLUMBUS HOSPITAL

WILLIAM H. GIBEL—g. Transurethral prostatic resection.

## GRANT HOSPITAL

EDWARD F. HENSE—g. Demonstration of cases.  
WILLIAM H. GIBEL—g. Operations.

## ILLINOIS MASONIC HOSPITAL

WILLIAM H. GIBEL and F. L. CHILDSWORTH—g. Nephrectomy.  
C. OTIS RITCH and O. F. HARRIS—g. Suprapubic cystotomy.  
EDWARD W. WHITE and CHARLES MICHA—ro. Prostatectomy.  
R. B. GARDNER—g. Nephrolithotomy.  
CLARENCE C. SALLER—g. Cystoscopic examination.

## MICHAEL REESE HOSPITAL

GUYA KOLBACHER, I. S. KOLL, J. S. EISENSTADT, H. C. ROSENICK, A. E. JONES, I. J. SHAPIRO, F. LEIBERSTEIN, and J. S. GROVE—g. Operations.

## NORWEGIAN-AMERICAN HOSPITAL

D. F. REDNICK—g. Transurethral resection of prostate.

## PASSAVANT MEMORIAL HOSPITAL

LEANDER W. RINA—g. Dry clinic. Chronic female urethritis and its treatment.  
L. L. VERNER—g. Diagnosis and treatment of tumors of the testes.

## ST LUKE'S HOSPITAL

L. E. SCHMIDT and staff—g. Operative and dry clinic.

## WASHINGTON BOULEVARD HOSPITAL

VICTOR J. O'CONNOR—g. Operative and dry clinic.

## Friday

## MIT SINAI HOSPITAL

H. C. ROSENICK—g. Operations.

## ST ELIZABETH'S HOSPITAL

T. G. McDONNALL—g. Nephrectomy, discussion of tumors of the kidney.

## Days to be announced

## COOK COUNTY HOSPITAL

HARRIS CUTLER, HARRIS C. ROSENICK, D. F. REDNICK, and L. L. VERNER—Operations.

## HOSPITAL OF ST ANTHONY DE PADUA

OTTO JORRA—Operative and dry clinic. Cystoscopy.

## RESEARCH AND EDUCATIONAL HOSPITALS

C. M. M. KRYVA, J. H. KLEINER and staff—g. Operative and dry clinic. Transurethral resection for hypertrophied prostate gland, suprapubic operation for hypertrophied prostate gland, nephrectomy and removal of aberrant vessels for hydrocephalus, repair of undescended testicle, total cystectomy following transplantation of ureters for bladder extrophy and results of correction of hypospadias and results of repair of undescended testicle.  
R. C. H. BROWN—g. Evaluation of urinary antiseptics in treatment of infections.

## ORTHOPEDIC SURGERY

*Monday*

## CHILDREN'S MEMORIAL HOSPITAL

FREMONT A. CHANDLER, F SEIDLER, C N PEASE, J R NORCROSS, and L SMITH—2 30 Operative and dry clinic Osteomyelitis, resection of ilium, rare infection of joint, tuberculous metatarsal and tuberculous ankle, patellar advancement, radial stripping for pronation deformity, unusual tumor of femur, unusual tumor of tibia, anterior dislocation of hip, torticollis, six cases, Erb's palsy, back knee, medial dislocation of patella, arachnodactylia, two cases, osteochondromatous of hip, overgrowth of spine

## RESEARCH AND EDUCATIONAL HOSPITALS

H B THOMAS, F W HARK, C N LAMBERT, and S L ODGERS—2 Operative and dry clinic Fusion of tuberculous hip, end results of tuberculosis of hip and spine, tendon transplant to shoulder, results of tendon transplant for brachial plexus injury to shoulder, use of shift casts in treatment of scoliosis

*Tuesday*

## CHILDREN'S MEMORIAL HOSPITAL

FREMONT A CHANDLER, F SEIDLER, C N PEASE, J R NORCROSS, and L SMITH—9 Operative clinic Extra-peritoneal resection of obturator nerve, two cases, Lowman operation for flat feet, triple arthodesis, Chandler patellar advancement operation, spine fusion, torticollis, four to five weeks of age, hip fusion operation, popliteal neurectomy

## COOK COUNTY HOSPITAL

ARTHUR H CONLEY and DONALD MILLER—9 Operations  
MARCUS H HOBART and FELIX JANSEY—10 Operative clinic Shoulder injuries

## EVANSTON HOSPITAL

R. C LONERGAN—9 Operative clinic Internal derangement of knee.

## MICHAEL REESE HOSPITAL

PHILIP LEWIN, D H LEVINthal, SIDNEY SIDEMAN, IRVING WOLIN, C N PEASE, FRANK GLASSMAN, and J G FINDER—9 Operative clinic Spinal fusion for scoliosis, Hoke arthrodesis for paralytic foot, laminectomy for intervertebral disc protrusion, poliomyelitis reconstruction, knee joint operation, hip joint operation

## ST JOSEPH HOSPITAL

Staff—9 Demonstrations Lantern slides and moving pictures of fractures

## SHRINERS' HOSPITAL FOR CRIPPLED CHILDREN

B H. MOORE and H A SOFIELD—9 Operative clinic.

*Wednesday*

## COOK COUNTY HOSPITAL

PHILIP LEWIN and SIDNEY SIDEMAN—9 Operative clinic  
DANIEL H LEVINthal and staff—9 Dry clinic  
DANIEL H LEVINthal—2 Operative clinic Derangement of the knee joint, spinal fusion, arthroplasty of hip using vitallium cup, arthrodesis of foot for poliomyelitis

## LORETTO HOSPITAL

BEVERIDGE H MOORE, JAMES A VALENTINE, and FRED CARLS—10 Operative and dry clinic.

## MICHAEL REESE HOSPITAL

Staff—2 Dry clinic Dunlop traction treatment of transcondylar fractures of the elbow in children, Russer method in scoliosis, club feet, Legg Calve-Perthes lesion, tuberculosis of the hip joint, tuberculosis of the spine, chronic osteomyelitis, ricketic deformities, post-operative laminectomy for disc protrusion, open reduction of congenital hip dislocation, flexorplasty of thumb, spina bifida with paraplegia, vitallium cup hip arthroplasty, leg equalization by epiphyseal arrests, leg shortening

## PASSAVANT MEMORIAL HOSPITAL

PAUL B MAGNUSON and JAMES K STACK—3 Dry clinic Joint debridement, cases illustrating end results of treatment of traumatic arthritis

## ST ANNE'S HOSPITAL

J J CALLAHAN and R E MEANY—9 Operations.

## ST LUKE'S HOSPITAL

HENRY B THOMAS—10 Bone changes in connection with thyroid disease

FRED W HARK—10 Bone changes in connection with sickle-cell anemia

CLAUDE N LAMBERT—10 Bone tumors

H. E. MOCK, ALVIN R MORROW, CHARLES E SHANNON, JOHN L LINDQUIST, and DONNELL C HOWE—11 Dry clinic Conservative treatment of fractures of neck of femur, fractures of fingers and toes, supracondylar fractures of humerus, malunited fractures of ankle

JOHN W ELLIS—11 Compression fractures of vertebrae using Ryerson hyperextension device

EDWIN W RYERSON—1 30 Dry clinic Shelf operation at hip, reconstruction of hip joint, osteotomy to produce back knee

FREMONT A CHANDLER—2 Operative clinic Aseptic necrosis of head of femur

ROBERT E RITTER—2 30 Arthroplasty

HAROLD A SOFIELD—3 Discussion of leg lengthening operations, indications and technique

Open forum—3 30

## SHRINERS' HOSPITAL FOR CRIPPLED CHILDREN

Staff—3 Clubfoot clinic.

## VETERANS ADMINISTRATION FACILITY

S K LIVINGSTON—10 Dry clinic Peripheral vascular diseases

*Thursday*

## ALEXIAN BROTHERS' HOSPITAL

GEORGE L APPELBACH—10 Demonstration of examination for lower back pain, non union of neck of femur

## ALBERT MERRITT BILLINGS HOSPITAL

DALLAS B PHEMISTER and C HOWARD HATCHER—9 Surgery of the hip joint, growth arrest operations

## COLUMBUS HOSPITAL

FREDERICK MCKILLER—9:30 Dry clinic.

## COOK COUNTY HOSPITAL

FRA G. MURPHY and WALTER FISCHER—9 Operations.  
E J BERENSON— Operations.  
ARTHUR H. CONLEY and staff— Dry clinic.

## GRANT HOSPITAL

JOSEPH E. ALLEGRETTI— Treatment of arthritis  
GEORGE L. APPELSHIM—2. Demonstration of examination  
for lower back pain open reduction of fracture.

## HOLY CROSS HOSPITAL

C. P. GALANTE. Rare bone tumors.

## ILLINOIS MASONIC HOSPITAL

CHARLES V. PEASE—9 Flexion of hip.  
WALTER R. FISCHER— Osteomyelitis.

## MICHAEL REESE HOSPITAL

PHILIP LEWIS, D. H. LEVINTHAL, SIDNEY SIDEMAN, IRVING  
WOLFF, C. N. PEASE, F. A. GLAWKIN, and J. G.  
FISCHER—9 Operative clinic Spinal fusion for scoliosis,  
Hoke arthrodesis for paralytic foot laminectomy for  
intervertebral disc protrusion polio myelitis reconstructive  
knee joint operation hip joint operation

## SHRINERS' HOSPITAL FOR CRIPPLED CHILDREN

B. H. MOORE and H. A. SOUTHERN—9 Operative clinic

## RESEARCH AND EDUCATIONAL HOSPITALS

H. R. THOMAS, F. W. HARR, C. N. LAMBERT, and S. L.  
OCCORS— Operative and dry clinic Open reduction  
for slipped epiphysis of the femur and insertion of  
fibular graft through neck and results of hip joint  
surgery particularly fractures and epiphyseal separations.

## Friday

## COOK COUNTY HOSPITAL

FRID W. HARR and CLAUDE N. LAMBERT—9 Operations.  
H. KRUEHMAN and GRAHAM A. K. BROWN— Operations.

## MT SINAI HOSPITAL

C. L. JACOB and LEO F. MILLER—9 Operations.

## PASSAVANT MEMORIAL HOSPITAL

EMIL H. CYR—2. Case presentations: Fusion of hip for  
tuberculosis; spinal fusion, presenting an unusual complication Brodie's abscess, illustrating results of chemotherapy after result of treatment of delayed union in  
fracture of humerus after treatment for fracture of calcaneus

## ST MARY OF NAZARETH HOSPITAL

L. M. CHASE—9 Operations

## FRACTURES AND OTHER TRAUMAS

## Monday

## COOK COUNTY HOSPITAL

WILLIAM R. CURRY, J. J. CALLAHAN and C. S. SCHICKEL—  
Operative clinic.

## Tuesday

## CHICAGO MEMORIAL HOSPITAL

T. C. BROWNING, EDWARD L. COMPERE, ARTHUR H. CONLEY, EMIL C. DEVAL, C. R. G. FORRESTER, A. H. MASON, FRID M. MILLER, S. PERRY ROGERS, HORACE SYMONS, and GEORGE M. LAYO—9 Operative and dry clinic

C. R. G. FORRESTER Shoulder fractures  
A. H. MASON Fractures of the scapula  
FRID M. MILLER and T. C. BROWNING Fractures of  
foot and ankle  
EDWARD L. COMPERE Vitamin D and calcium in  
fracture repair  
S. PERRY ROGERS A talk on fractures  
EMIL C. DEVAL Internal semilunar cartilage as  
factor in industrial surgery  
HORACE SYMONS Treatment of fractures of spine

## EVANSTON HOSPITAL

MARCE H. HENRY Mal united Colles fracture  
DAVID J. CLAR Intramedullary nailing rib and  
horn four year end result

## RAVENSWOOD HOSPITAL

Staff—2. Demonstration of cases

## ST JOSEPH HOSPITAL

H. C. MCKEY—9 Demonstration, Moore picture  
and slides of fractures of the neck of femur and demonstration of device used in securing x-ray films during  
the stage of reduction

## WASHINGTON BOULEVARD HOSPITAL

VICTOR R. MIER—9 Operative and dry clinic.

## Wednesday

## CHILDREN'S MEMORIAL HOSPITAL

VICTOR H. MONTGOMERY, J. J. LAYO, and W. J. POTT—  
90 Demonstration of cases Fractures of humerus,  
supracondylar fractures of humerus bone cysts, skull  
fractures

## COOK COUNTY HOSPITAL

GEORGE L. APPELSHIM— Operative clinic Flange operation  
for fractured neck of femur open reduction of the  
forearm with intramedullary peg reconstruction of  
malunited Colles fracture

## HENROTIN HOSPITAL

RALPH A. KORDS—9 Operations  
JOHN A. G. AIR—9 Demonstration of lantern slides  
Fracture of distal end of radius  
JOHN J. FARRINGTON—9 Dry clinic Care of fractures

## JACKSON PARK HOSPITAL

F. G. M. BROWN—9 Operations

## MERCY HOSPITAL

F C JACOBSEN—2 Industrial fractures  
 JOHN D CLARIDGE—2 Fractures of the humerus  
 J M LEONARD—4 Forearm fractures

## PASSAVANT MEMORIAL HOSPITAL

PAUL B MAGNUSON and JAMES K STACK—3 Dry clinic,  
 Results of treatment of various types of fractures of the  
 neck of the femur, treated by selected methods for the  
 individual case The effect of trauma on prolongation  
 of the symptoms of arthritis Arthritis resulting purely  
 from trauma, with demonstration of pathological sec-  
 tions and specimens in color

## ST ANNE'S HOSPITAL

J J CALLAHAN—1 Dry clinic Shoulder injuries, con-  
 genital dislocation of patella  
 T E MEANY—1 Dry clinic Fracture of femur in children  
 —Paget's disease

## SWEDISH COVENANT HOSPITAL

O T ROBERG and O T ROBERG, Jr —9 Fractures

*Thursday*

## COLUMBUS HOSPITAL

GEORGE N BEECHER—9 Dry clinic

## COOK COUNTY HOSPITAL

WILLIAM R CUBBINS and JAMES J CALLAHAN—1  
 Operations

## NORWEGIAN AMERICAN HOSPITAL

H A SOFIELD—11 Steel pin fixation of fractures of neck  
 of the femur

*Friday*

## COOK COUNTY HOSPITAL

COOK COUNTY GRADUATE SCHOOL OF MEDICINE  
 Staff—1 Demonstration on cadaver Fractures and  
 traumatic surgery

## THORACIC SURGERY

*Tuesday*

## COOK COUNTY HOSPITAL

JEROME R HEAD—10 Operative clinic Lung abscess,  
 empyema, and other intrathoracic infections  
 R B BETTMAN—2 Operations Intrathoracic tumors

## EVANSTON HOSPITAL

JEROME R HEAD—9 Operations

## RESEARCH AND EDUCATIONAL HOSPITALS

WILLARD VAN HAZEL—9 Operative and dry clinic  
 Thoracoplasty, thoracotomy for chronic empyema, dis-  
 cussion of surgical drainage of lung abscess, lobectomy  
 for bronchiectasis

*Wednesday*

## ST LUKE'S HOSPITAL

WILLARD VAN HAZEL—9 Operative and dry clinic  
 Thoracoplasty Treatment of lung abscess

## PRESBYTERIAN HOSPITAL

Staff—9 Operative and dry clinic

EDWIN M MILLER Improved methods in dealing with  
 supracondylar fractures of the elbow, resection of  
 tumor of metacarpal bone with free graft from tibia,  
 x-rays, microscopic pathology and clinical result

W J POTTS Improved method of immobilization of  
 fractures of both bones of leg

EGBERT H FELL Fractures of the capitellum of the  
 humerus

EDWARD L COMPERE Evaluation of methods of in-  
 ternal fixation of fractures of neck of the femur

E J BERKHEISER Dislocations of cervical vertebrae,  
 arthrodesis of shoulder, tendon transplants

KELLOGG SPEED Reconstruction problems following  
 trauma in hip region, illustrated talk on wounds of  
 war, fractures about elbow

*Days to be Announced*

## HOSPITAL OF ST ANTHONY DE PADUA

F W SLOBE Operative clinic Fractures, tendon sutures,  
 care of wounds, treatment of burns

## WESLEY MEMORIAL HOSPITAL

Staff—9 Operative and dry clinic

O H HORRALL Fractures of the os calcis, colored mo-  
 tion pictures Operation for semilunar cartilage, open  
 reduction of fracture of the tibia

F M JANSEY Fractures of the pelvis Operation for  
 open reduction of fracture of the humerus

H KELIKAN Fractures involving the knee joint Op-  
 eration for open reduction, fracture of the shaft of the  
 femur

P H KREUSCHER Fractures about the hip joint  
 Colles and Pott's fractures Operation for recurrent  
 dislocation of the shoulder, removal of semilunar  
 cartilage

P B MAGNUSON Fractures and other injuries of the  
 spine.

RALPH MACDONALD Fractures about the shoulder

K PENHALE Traumatic injuries of the face and jaws

## VETERANS ADMINISTRATION FACILITY

JEROME R HEAD—11 Operative and dry clinic Stages I  
 and II of a new muscle splitting thoracoplasty, extra-  
 pleural pneumothorax, Monaldi suction treatment of  
 tuberculous cavities

*Thursday*

## ALBERT MERRITT BILLINGS HOSPITAL

W E ADAMS—9 Intrathoracic operations with special  
 reference to reduced lung function and partial pressure  
 anesthesia

## ALEXIAN BROTHERS' HOSPITAL

MINAS JOANNIDES and LOUIS J MILLER—9 Operative  
 clinic First stage thoracoplasty, extrapleural pneumolys-  
 is, axillary approach, lobectomy for bronchiectasis Dry  
 clinic Hedblom's syndrome, clinical and radiological  
 aspects, chronic suppuration of the lung in relation to  
 carcinoma of the lung

## ILLINOIS MASONIC HOSPITAL

MIRAS J. JONES and W. E. KERRIN—*g.* Operative clinic.

MIRAS J. JONES and LOUIS J. MILLER—*g.* Abdominal drainage, extrapleural pneumothorax, phrenic neurectomy and anterior thoracoplasty.

LOUIS J. MILLER—*g.* Surgical aspects of pulmonary abscess and primary carcinoma of the lung.

## MICHAEL REESE HOSPITAL

S. L. GOLDBERG—*2.* Stab wound of pericardium and lung. NATHAN N. CROOK—*2.* Concepts in treatment of empyema.

M. BIERENTHAL—*1.* A ten year review of collapse therapy in treatment of tuberculosis.

R. B. BETTMAN and WILLIAM T. VANCE, JR.—*g.* Surgical approach to thoracic esophagus.

R. B. BETTMAN—*2.* Interesting cases in thoracic surgery. B. B. LEVINE—*2.* Anesthesia in thoracic surgery.

## Friday

## ALBERT MERRITT BILLINGS HOSPITAL

W. E. ANASTAS—*g.* Thoracoplasty—lobectomy.

## MICHAEL REESE HOSPITAL

R. B. BETTMAN and W. T. VANCE, JR.—*g.* Operations.

## MUNICIPAL TUBERCULOSIS SANITARIUM

MIRAS J. JONES—*g.* Collapse therapy clinic.

## PRESBYTERIAN HOSPITAL

JOHN M. DORRIS—*g.* Operative and dry clinic. Intrathoracic tumors and diaphragmatic hernia.

## NEUROSURGERY

## Tuesday

## ALBERT MERRITT BILLINGS HOSPITAL

P. CL. BUCK—*g.* Operations.

## RESEARCH AND EDUCATIONAL HOSPITALS

ERIC OLDBERG, PIERCEAL BAILEY, W. A. GUTTAPORE, and MILTON TOSLEY—*g.* Operations and demonstrations.

## ST. LUKE'S HOSPITAL

ERIC OLDBERG and WERLEY A. GUTTAPORE—*g.* Operations and demonstrations.

## Wednesday

## COOK COUNTY HOSPITAL

HAROLD C. VOLZ—*g.* Dry clinic. Operative treatment of head injuries.

ADRIEN VERBERGHE—*g.* Operations and demonstrations.

## PASSAVANT MEMORIAL HOSPITAL

LOYAL D. BISHOP and JOHN MARTIN—*g.* Dry clinic. Discussion of results of surgical treatment of cerebral hypertension, discussion of tumors of the nasopharynx, producing intracranial symptoms.

## RESEARCH AND EDUCATIONAL HOSPITALS

ERIC OLDBERG, PIERCEAL BAILEY, W. A. GUTTAPORE, and MILTON TOSLEY—*g.* Operations and demonstrations.

## OPHTHALMOLOGY

## Tuesday

## CHICAGO MEMORIAL HOSPITAL

FRANCIS M. CRAIG, HERBERT P. D. VIDVANSKY, and GLENN VETTERLI—*g.* Operative and dry clinic.

## EVANGELICAL HOSPITAL

G. HERBERT, MIRAS J. JONES, E. A. MILLER, and J. H. F. O'NEILL—*g.* Operations.

## Thursday

## ALBERT MERRITT BILLINGS HOSPITAL

PAUL BUCK—*g.* Operations.

## COOK COUNTY HOSPITAL

ADRIEN VERBERGHE and associates—*g.* Dry clinic. Discussion of the brain.

## MERCY HOSPITAL

HAROLD C. VOLZ—*g.* Protruding lateral vertebral disc.

## MICHAEL REESE HOSPITAL

ADRIEN VERBERGHE—*2.* Operative and dry clinic.

## RESEARCH AND EDUCATIONAL HOSPITALS

ERIC OLDBERG, PIERCEAL BAILEY, W. A. GUTTAPORE, and MILTON TOSLEY—*g.* Operations and demonstrations.

## Friday

## PRESBYTERIAN HOSPITAL

ADRIEN VERBERGHE—*g.* Operations.

## RESEARCH AND EDUCATIONAL HOSPITALS

ERIC OLDBERG, PIERCEAL BAILEY, WERLEY A. GUTTAPORE, and MILTON TOSLEY—*g.* Operations and demonstrations.

## ST. LUKE'S HOSPITAL

ERIC OLDBERG and WERLEY A. GUTTAPORE—*g.* Operations and demonstrations.

## EVANSTON HOSPITAL

G. R. SOPER, GLENN J. GREEN, JR., and R. H. HENDERSON—*g.* Operations.

## GRANT HOSPITAL

OSCAR H. KRAFT—*g.* Operative and dry clinic.

## ILLINOIS EYE AND EAR INFIRMARY

THOMAS D. ALLEN, J. M. LEITCH, and G. W. VETTERLI—*g.* Operative clinic. Cataracts, ptosis, glaucoma.

PASSAVANT MEMORIAL HOSPITAL

SANFORD GIFFORD and associates—9 Dry clinic Retina detachment, retinoplasty, plastic surgery of the eyelids

RESEARCH AND EDUCATIONAL HOSPITALS

H J SMITH—9 Management of foreign bodies  
HALLARD BEARD—9 Surgical treatment of glaucoma

ST JOSEPH HOSPITAL

Staff—9 Operative and dry clinic

ST LUKE'S HOSPITAL

ELMER VORISEK—2 Demonstration of cases

WESLEY MEMORIAL HOSPITAL

T P O'CONNOR—9 Operative and dry clinic  
WILLIAM A. MANN and IRVING PONTENNEY—10 Operative and dry clinic

Wednesday

CHILDREN'S MEMORIAL HOSPITAL

RICHARD GAMBLE and associates—4 Dry clinic

COOK COUNTY HOSPITAL

JAMES E. LEBENSOHN and WILLIAM F. MONCREIFF—9 Operations

ILLINOIS EYE AND EAR INFIRMARY

PETER C. KRONFELD—9 Gonioscopy  
KATHARINE CHAPMAN—9 Orthoptic clinic  
ROBERT VON DER HEYDT—3 Slit lamp demonstration

MERCY HOSPITAL

CARL F. SCHAUB and L. G. HOFFMAN—9 Operative and dry clinic Demonstration of verified cases of optic-chiasmatic arachnoiditis

ST BERNARD'S HOSPITAL

C. P. SULLIVAN Cataract operations

SWEDISH COVENANT HOSPITAL

R. A. DAVIS—9 Operative and dry clinic Glaucoma

Thursday

COLUMBUS HOSPITAL

MICHAEL GOLDENBURG—9 Operations

EVANGELICAL HOSPITAL

G. HENRY MUNDT, J. R. SMITH, EVAN A. MILLER, and J. H. I. O'NEIL—9 Operations

ILLINOIS EYE AND EAR INFIRMARY

LOUIS G. HOFFMAN—9 Operative and dry clinic Verhoeff suture

E. K. FINDLAY—10 Dry clinic

E. K. FINDLAY and DR. CORBOY—2 Operative clinic

ST LUKE'S HOSPITAL

E. V. L. BROWN—9 Demonstration of cases  
FRANK BRAWLEY and JAMES W. CLARK—2 Demonstration of cases

Friday

COOK COUNTY HOSPITAL

SANFORD R. GIFFORD—9 Operations

EDWARD A. ROLING—10 Operations

ILLINOIS EYE AND EAR INFIRMARY

PETER C. KRONFELD—9 Gonioscopy

KATHARINE CHAPMAN—9 Orthoptics

SAMUEL J. MEYER—2 Operative clinic Cataracts, glaucoma

RESEARCH AND EDUCATIONAL HOSPITALS

CARL APPLE—9 Recession operation for strabismus

J. W. CLARK—9 Intracapsular extraction of cataract

ST ELIZABETH'S HOSPITAL

F. A. DULAK and OSCAR CLEFF—3 Operative and dry clinic Glaucoma

ST LUKE'S HOSPITAL

RICHARD GAMBLE—3 Demonstration of cases

OTOLARYNGOLOGY

Monday

ILLINOIS EYE AND EAR INFIRMARY

SAMUEL SALINGER—2 Operative and dry clinic Plastic surgery about the nose

Tuesday

ALBERT MERRITT BILLINGS HOSPITAL

JOHN R. LINDSAY—2 Exhibit and demonstration Suppurations of the petrous pyramid, anatomical, pathological, and roentgenological considerations

CHICAGO MEMORIAL HOSPITAL

OSCAR CLEFF, ALFRED LEVY, ROBERT LEWY, JAMES B. McBEAN, GORDON H. SCOTT, and RICHARD W. WATKINS—2 Operations

COOK COUNTY HOSPITAL

JACOB LIPSCHUTZ—2 Operative and dry clinic  
RAYMOND W. KERWIN—2 Operative and dry clinic

EVANGELICAL HOSPITAL

G. HENRY MUNDT, J. R. SMITH, EVAN A. MILLER, and J. H. F. O'NEIL—9 Operations

EVANSTON HOSPITAL

T. C. GALLOWAY, H. C. BALLENGER, and L. J. LAWSON Operations

T. C. GALLOWAY Anerobic bone infections about the head

ILLINOIS EYE AND EAR INFIRMARY

T. P. O'CONNOR—9 Plastic surgery, demonstration of patients, lantern slides

CARL CRISTOPH—9 Operative clinic Radical mastoid

E. J. BLONDER—2 Labyrinthine diagnosis and demonstration of the galvanic following reaction

M. A. GLATT—2 Operative clinic Radical mastoid and external frontal

RESEARCH AND EDUCATIONAL HOSPITALS

P. H. HOLINGER and A. H. ANDREWS, JR.—9 Bronchoscopies



F. L. LUDWIG and staff—2. Otorhinolaryngological operations.

### ST JOSEPH HOSPITAL

Staff—9 Operative and dry clinic.

### WESLEY MEMORIAL HOSPITAL

T. P. O'CONNOR and LEONARD C. DELOSTER—4. Operative and dry clinic.  
TAYLOR CARR— Operative and dry clinic.

### Wednesday

#### COOK COUNTY HOSPITAL

S. J. FRANKLIN—4-10 Operative and dry clinic.  
JACOB LEMONICK—2. Operative and dry clinic.

#### ILLINOIS EYE AND EAR INFIRMARY

DR. WOODBURY—Laryngeal stoma and ear cases, external, mastoid and sinus surgery.  
T. P. O'CONNOR—2. Operative clinic.

#### JACKSON PARK HOSPITAL

NOAH FOX—9. Operations

#### PASSAUNT MEMORIAL HOSPITAL

JOSEPH F. DELANEY and associates—9. Dry clinic. Laryngoscopy, bronchoscopy, esophagoscopy; presentation of exhibits and cases, carcinoma of larynx.

#### ST ANNE'S HOSPITAL

J. W. HAYDEN—9. Operations.

#### ST MARY OF NAZARETH HOSPITAL

F. J. PRZYBYLO—9. Otolaryngological operations

#### VETERANS' ADMINISTRATION FACILITY

MAX CUTLER— Dry clinic. Carcinoma of the mouth and larynx. Problems in diagnosis and treatment, indications for surgery and irradiation in laryngeal carcinoma; presentation of cases.

### Thursday

#### ALBERT MERRITT BILLINGS HOSPITAL

JOHN R. LYNDS— Exhibit and demonstration. Separations of the petrous pyramid, anatomical, pathological, and roentgenological considerations.

#### COOK COUNTY HOSPITAL

RAYMOND W. KERN— Operative and dry clinic

#### EVANGELICAL HOSPITAL

G. HEINZ, M. DEITZ, J. R. SMITH, E. A. MILLER, and J. H. F. O'NEIL—9. Operations

#### GRANT HOSPITAL

CARROLL W. STUART— Oral surgery.  
S. H. SOMMER— Nose and throat operations

#### ILLINOIS EYE AND EAR INFIRMARY

E. J. BLONDEL—9. Operative and dry clinic. Radical mastoid.  
M. A. GLATT— Osteomyelitis of the frontal bone.

### ILLINOIS MASONIC HOSPITAL

AL. SCHWARTZ—9. Tonsillectomy.  
ARTHUR H. GESSER—9. Deviated septum.  
MAURICE H. COTTELL and MILTON LARSEN—10. Maxillofacial surgery.  
HERBERT F. T. LOW— Drainage maxillary sinus.  
JOHN GRUBBIE and PETER J. MELNICK— Diagnosis and treatment of carcinoma.

### MERCY HOSPITAL

PETER F. LUDWIG—9. Disturbances of equilibrium.  
CARL H. CHRISTENSEN—9. Laryngeal malignancies.  
HERBERT NASE—9. External operations.  
G. T. JOSE—9. Anatomy of the temporal bone.

### MUNICIPAL TUBERCULOSIS SANITARIUM

GEORGE HOGGERS— Bronchoscopy in tuberculous

### NORWEGIAN-AMERICAN HOSPITAL

M. A. GLATT—9. Control of hemorrhage in tonsillectomy.  
J. W. HARNED—9-10. Danger signs in mastoid infection.

### ST LUKE'S HOSPITAL

PETER H. HOLMSTEDT and ALBERT H. ANDREWS, J.— Personal endoscopy, clinical presentation of bronchial and esophageal cases.  
HORACE R. L. COLE, WALTER H. THORNTON and staff—3. Operative and dry clinic. Salivary gland therapy in acute sialadenitis and acute otitis media. Proctitis treatment for sinusitis.

### Friday

#### CHILDREN'S MEMORIAL HOSPITAL

PETER H. HOLMSTEDT and ALBERT H. ANDREWS—10-12. Bronchoscopic clinic

#### COOK COUNTY HOSPITAL

JACOB LEMONICK, T. C. GALLOWAY and R. W. KERN—4. Operative and dry clinic.

#### ILLINOIS EYE AND EAR INFIRMARY

ALFRED LEVY— Operative clinic

#### MT SINAI HOSPITAL

S. M. MOSE—9. Operations.

#### RESEARCH AND EDUCATIONAL HOSPITALS

L. W. SCHULTZ—9. Operative and dry clinic. Cleft palate operation; presentation of interesting cases in oral surgery; stabilization of joints by injecting sclerosed agent; bilateral cleft lip operation; bilateral transmandibular dislocation for 34 months; reduction, cord results with motion pictures; vitalization cup arthroplasty of temporomandibular joint, presentation of case.

#### ST ELIZABETH'S HOSPITAL

J. G. WEBER and T. V. CARROLL—3. Operative and dry clinic. Complications in mastoid surgery

# SURGERY

## GYNECOLOGY AND OBSTETRICS

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### BLOOD AND LYMPH VESSEL TUMORS

A Report of 1,056 Cases

WILLIAM L. WATSON, M.D., F.A.C.S., and WILLIAM D. MCCARTHY, M.D.,  
New York, New York

**A**N angioma, as defined by Ewing, is a true neoplastic process involving vascular or lymphatic tissue. In this respect an angioma differs distinctly from simple, self-limiting vessel hypertrophy such as occurs in granulation tissue, and it bears no relation to the ordinary dilatation of previously formed vessels such as occurs in varices. It is generally believed that simple angiomas are congenital in nature and have their origin in embryonic sequestrations of mesodermal tissue, and also it seems well established that the three types of benign blood and lymph vessel tumor (hemangioma, lymphangioma, and hygroma) not only have a common origin, but grow in an identical fashion by projecting buds of endothelial tissue (Ribbert and Goetsch). The present study brings out an additional fact of certain similarities in the response of these growths to the various therapeutic agents.

Since blood and lymph vessel tumors have a common origin, develop and grow in identical fashion, and show certain common features in response to treatment, it seems logical and desirable to us that they be studied in detail as a group. In this report it has been our purpose to classify these tumors, and, in so

From the Memorial Hospital

far as possible, describe and correlate their known therapeutic responses with their clinical and pathological characteristics. Another aim has been to evaluate the different treatment measures and point out certain pitfalls and hazards to be avoided in the management of these tumors. The present report is a study of the patients with benign blood and lymph vessel tumors admitted to Memorial Hospital during the years 1931 to 1939. A group of 1,056 patients with a total of 1,363 lesions (Table I) is suitable for statistical study.

#### HEMANGIOMA

This type of blood vessel tumor inherits from its embryonic parent a certain power of irregular and unrestrained growth. The average hemangioma pursues a benign course and, if untreated, grows slowly up to adult life. All hemangiomas, however, do not follow this general rule. Occasionally one will suddenly develop rapid acceleration of growth, become locally destructive, and may even cause death by hemorrhage or sepsis if not treated promptly. In all but the racemose type, tumor growth generally stops with full body growth.

Hemangiomas enlarge and develop by extending solid "buds" of endothelium into

TABLE I.—BLOOD AND LYMPH VESSEL TUMORS  
—SUMMARY—IN 1,036 PATIENTS STUDIED

Hemangioma	
Cavernous	93
Capillary	20
Bone	5
Muscle	
Special Organs	4
Racemose type	9
Diffuse systemic type	9
Port. Joe stains	9
Rendu-Osler Weber disease	9
	—
Lymphangioma	308
Hygroma	4
	—
Total individual lesions of all types	363

TABLE II.—BLOOD AND LYMPH VESSEL TUMORS  
—HEMANGIOMA, ITS RELATION OF PA-  
TIENT'S AGE TO RADIOSENSITIVITY OF  
TUMOR

Age	Total cases	Percentage good response
Cases	Percent	
1-3 months	20	20
4 to 6 months	37	34
7 to 9 months	9	5
10 months	5	79
1 year	23	8
Over 1 year		
Total	30	

Primary regression of 20 cases of hemangioma treated with single dose of radium radiation in 10 cases plus placebo treatment.

Conclusion: The radiosensitivity of angiomata varies inversely with the age of the patient.

Hemangiomas make up the largest single group of neoplasms occurring in childhood. Females are more frequently affected than males, the ratio in this series being 65 per cent to 35 per cent. The relative frequency of this lesion in females as compared with males is a consistent feature in the world literature of this growth, and in some clinics the proportion runs as high as 3 to 1. Although no acceptable explanation for this higher female incidence has ever been offered, it is suggested that hemangiomas may in some fashion be related to the female sex hormones, and in this connection it is of interest to note that a hemangioma may start or increase rapidly in size with the onset of the menses or at the beginning of pregnancy. Only one negro boy was treated, and this low incidence (0.1 per cent) suggests that hemangiomas are relatively rare lesions in the negro race.

The head and neck regions make up less than one seventh of the total body surface but more than one-half (56 per cent) of all hemangiomas in this series occurred in those locations. The anatomical distribution of all the lesions in this series was head 51 per cent neck, 4 per cent trunk, 23 per cent extremities 19 per cent and genitalia, 2 per cent.

#### CLASSIFICATION

A rigid and inclusive classification of hemangiomas would be difficult and yet to eliminate confusion one must be somewhat arbitrary. We feel that a satisfactory classification should attempt to group the lesions according to their clinical and pathological characteristics in so far as they tend to serve

adjacent tissues. These solid cords of endothelial tissue then become canalized and establish communication with the parent vessel. They do not, however invade or communicate with surrounding normal vessels. The histological studies carried out in preparing this report tend to confirm Ribbert's original theory that a hemangioma, with the exception of the racemose type, has no anastomotic connection with surrounding vessels and possesses only one afferent and one efferent vessel. The occasional spontaneous regression of a hemangioma results from the accidental, thrombotic occlusion of this very tenuous blood supply.

The hemangioma material available for this report consists of 1,001 patients presenting a total of 1,308 lesions. Multiple lesions were noted in 16 per cent of the patients. The cases included in this series represent 5 per cent of all the admissions to the Memorial Hospital during the 8 year period under consideration.

Strongly supporting the theory that hemangiomas are of congenital origin is the fact that 73 per cent of the patients presented evidence of tumor at birth. More than 85 per cent of the lesions had developed before the end of the first year and undoubtedly many of these were present at birth but were unnoticed because of their minute size. There is also reason to believe that many of the hemangiomas which allegedly did not appear until adult life were present earlier but were not noticed until they suddenly began to enlarge.

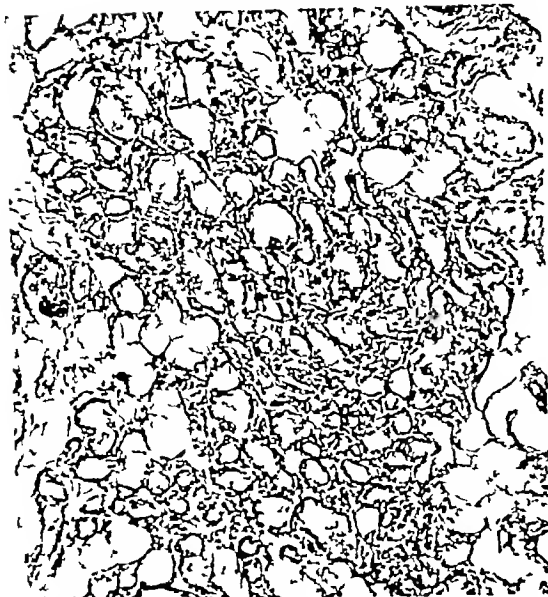


Fig 1 A.P. Capillary hemangioma. The capillary vessels are lined with a single layer of well differentiated endothelium. The stroma is scanty  $\times 65$

the dictates of the various methods of therapy. The following simplified classification of hemangiomas is proposed primarily because it includes the therapeutic point of view and is based strictly on comparative clinical, pathological, and therapeutic considerations (1) capillary hemangioma, (2) cavernous hemangioma, (3) angioblastic or hypertrophic hemangioma, (4) racemose hemangioma, (5) diffuse systemic hemangioma, (6) metastasizing hemangioma, (7) nevus vinosus or port-wine stain, (8) hereditary hemorrhagic telangiectasis (Rendu-Osler-Weber disease).

1 *The capillary form of hemangioma* consists of a new-growth of capillary blood vessels with well differentiated endothelium and delicate connective tissue stroma. The capillary vessels are lined with a single layer of endothelial cells and their lumens usually contain only a few blood cells. As a rule, this type clinically appears as a well circumscribed, finely lobulated, slightly elevated tumor, bright red in color (Figs 1, 2, 3). These growths are usually situated superficially in the skin and range from a few millimeters to several centimeters in diameter. The rapidly growing lesions may attain a thickness of 1



Fig 2, left Ten month old girl with a slightly raised, bright red, capillary hemangioma measuring 3 centimeters in diameter which blanched poorly on pressure.

Fig 3 Same hand 8 months later following 8 applications of solid carbon dioxide snow.

to 2 centimeters and simulate the cavernous type. Because of its narrow vessel lumen, the capillary hemangioma blanches poorly under pressure and is not as compressible as a cavernous hemangioma.

Closely associated with the capillary type are the mixed forms such as angiolipoma, angiofibroma and the stellate or "spider-web" hemangioma. The stellate hemangioma, so called because of its large central capillary and fine stellate vessels, usually occurs in adults and rarely exceeds 4 or 5 millimeters in diameter.

2 *The cavernous hemangioma* is composed of thin walled, endothelium-lined, widely dilated blood sinuses engorged with blood cells (Figs 4, 5, 6). The lesions are soft, elevated, and generally poorly circumscribed. They are purplish blue in color, easily compressible, and blanch readily under pressure. The deeper type is more diffuse and assumes a darker bluish color.

Cavernous hemangiomas generally have a greater thickness than the capillary ones and extend deeper into the subcutaneous tissues. They are more extensive, tend to be aggressive, and may attain great size. In the neck there is the constant danger of this tumor developing arteriovenous connections and resulting in fatal hemorrhage. Mixed capillary-cavernous types are common, the capillary portions usually surmounting the cavernous lesion in the overlying skin.

The subforms of cavernous hemangioma comprise almost all the hemangiomas of spe-



Fig. 4. LR Cavernous hemangioma. The thin walled, endothelium lined, highly dilated blood sinuses are congested with blood cells. These lesions are easily compressible and quite suitable for injection therapy.  $\times 65$ .



Fig. 5. Left, G.C. Angerath, on erosive hemangioma of cheek. Raised, purplish red, compressible lesion measuring 6 by 5 by 1 centimeters. It was noted at birth. Treatment consisted in radon plaque followed by insertion of gold filtered radon seeds.

Fig. 6. Result 4 years later. There is slight radiation fibrosis.

dial organs, such as liver intestine bone and muscle.

Cavernous hemangiomas of the liver are relatively common but because of their asymptomatic nature are usually found only on postmortem examination. They may grow to a very large size and are invariably located near the liver surface.

Hemangioma of bone is clinically uncommon and occurs chiefly in the lumbar vertebrae (Figs 7 and 8). Topfer routinely sectioned vertebrae in 2154 postmortem examinations and found angiomas in 12 per cent of the cases. Few of these patients had shown any symptoms. In our series of 5 cases of bone angioma, 3 occurred in the bodies of the lumbar vertebrae 1 in a mandible and 1 in a rib. In the vertebral series, the symptoms were characteristic of spinal cord compression. Roentgen findings in all 3 cases consisted of the typical "vertical striations" as noted by Bucy and Capp in their excellent review of this subject.

Hemangioma of striated muscle (Fig 9) was noted in 10 cases, an incidence of 1 per cent, and all lesions but one developed before

the age of 10. In 6 cases (60 per cent) the lesions were located in the extremities, chiefly the thigh. Six patients were females and 4 were males. Symptoms were strikingly similar in most instances and consisted of pain, functional impairment and diffuse tumefaction which decreased with limb elevation. Aspiration of blood from the tumor and the detection of phlebolith shadows on roentgen examination assist in establishing a correct diagnosis.

3. *The angioblastic or hypertrophic type of hemangioma* occurs chiefly in the skin (Figs. 10, 11, 12). It appears as a solid elevated, purplish red lesion which is not compressible. On section it consists of a solid mass of endothelial cells with a minimum of patent vessels. Vessel lumens have been obliterated as a result of the rapid proliferation of the embryonic endothelium. The pure type is often mistaken microscopically for a hemangiosarcoma and as a matter of fact, is frequently found to be locally aggressive and is prone to recur after operation.

4. *The racemose or cirrroid type of hemangioma* a relatively rare lesion consists of a pulsating mass of dilated thickened tortuous arterioles and proliferating capillaries which have established communication with surrounding normal blood vessels. Clinically it appears as a soft, bulky bluish-red pulsating mass suggesting a writhing mass of earth worms. These destructive lesions appear chiefly in adults and are characterized by



Fig 7 SW Cavernous hemangioma of rib Large dilated sinuses filled with blood and destroying bone The patient, a 22 year old female, complained of pain and slight tumefaction of the tenth rib of several months' duration The rib was excised and there has been no recurrence  $\times 75$



Fig 8 NG Hemangioma of the second lumbar vertebra Note the characteristic vertical striations The patient, a 33 year old female, complained of pain localized over the dorsal spine of 4 years' duration The lesion was treated with divided doses of high voltage roentgen therapy for a total of 1500 r with relief of symptoms

their sudden onset They develop externally and are located almost solely about the face or neck Not infrequently they appear to spring from previously quiescent port wine stains On rare occasions they appear as a diffuse lesion involving an extremity Once having established communication with a large blood vessel, such as the carotid artery, this tumor becomes locally destructive by reason of the constant arterial pulsations, and it may then erode the cranial vault or orbit, or bulge into the oral cavity and lead to fatal hemorrhage (Figs 13, 14, 15)

Nine cases of the racemose type are included in this report and they comprise the largest series of these tumors to appear in the medical literature Two patients were infants and the others adults The sex incidence was nearly equal, and all the lesions occurred about the head and neck

5 *Diffuse systemic hemangioma* The term is applied to a small group of tumors char-

acterized by a diffuse overgrowth of a locally invasive capillary or cavernous hemangioma (Figs 16, 17) An entire extremity is usually affected and the growth often appears to be a mixed hemolymphangioma Due to the abnormal blood supply, almost every one of the 9 cases in our series showed visible and palpable evidence of tissue hypertrophy In 2 patients definite angiomatous lesions were also observed in internal organs In 1 case the kidney was involved and in the other case the sigmoid was the site of the lesion Hence, the usage of the term "systemic"

6 The so-called *metastasizing hemangioma* is characterized by metastases which are as benign microscopically as the primary lesion Only 4 proved cases have appeared in the literature (Robinson and Castleman) In 2 of them the primary lesion occurred in the breast All 4 patients had visceral or pulmonary metastases Recently, a similar case affecting the forearm was reported (Ward and Jones)



Fig. 9. J.D. Cavernous hemangioma of muscle. Note the dilated, cavernous spaces circumscribing and destroying muscle bundles. The patient, a 14-year-old female with painful, diffuse swelling of the forearm, which measured 7 by 4 by 1 centimeters and had been growing for 5 years. The lesion was successfully excised and no recurrence has been reported following operation.  $\times 65$ .

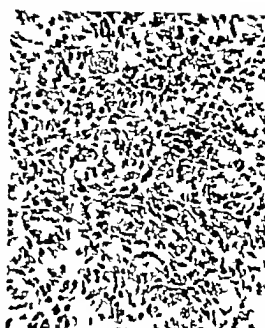


Fig. 10. B.K. Hypertrophic type of hemangioma. Note the marked proliferation of endothelial cells obliterating the vessels and forming sheets of rather solid tissue. Such features often lead to an erroneous diagnosis of sarcoma. This lesion was soft, bluish, elevated, and measured 4 by 1 by 1 centimeters. It was not compressible and did not blanch with pressure. The patient was a 2-month-old female. The lesion was on the skin of the shoulder and was not noted at birth and grew rapidly.  $\times 90$ .



Fig. 11. Left: L.H. Hypertrophic type of hemangioma. Raised, irregular, rather firm, light bluish hemangioma which blanched poorly on pressure. It measured 4 centimeters in its greatest diameter and was 5 centimeters in thickness. The patient was a 1-year-old female. The lesion had been present since birth, and there was gradual growth. The lesion was removed by repeated partial excisions. No recurrence.

Fig. 12. Photograph of patient showing cosmetic result 5 years after operation.

*Venus sinus or port wine stain* is a diffuse telangiectasia of superficial vessels of the derma. On section, a very narrow superficial zone of scattered dilated vessels lined with flattened adult endothelium is seen (Figs. 18-19). The proliferative mass characteristic of a real hemangioma is lacking. Clinically the lesion presents a flat, irregular bright purple patch in the derma which blanches on pressure. In all our 19 cases, the growth was noted at birth and showed no tendency to grow. Twelve patients (70 per cent) were males; a peculiar reversal of sex incidence when considered with hemangomas as a group. In 88 per cent the lesions were located on the face or neck.

*Hereditary hemorrhagic telangiectasia or Rendu-Osler-Weber disease.* Three classical requisites are necessary to establish this diagnosis. First a history of repeated hemorrhages (usually profuse epistaxis) second, telan-



Fig 13 N C Racemose type of hemangioma. Note the thickened arteriole showing considerable cellular proliferation in its walls. The smaller surrounding, thin walled vessels communicate directly with such an arteriole resulting in a cirroid, pulsating mass. Clinically, the lesion appeared as a very early, soft, pulsating, bluish mass 3 centimeters in diameter and  $1\frac{1}{4}$  centimeters in thickness in the skin of the upper lid of a 16 year old girl. It was successfully treated by vessel ligation and sodium morrhuate injections.

glectatic lesions in the mucous membranes of the nasal or oral cavities, viscera, and occasionally in the skin, and third, familial occurrence. Eighty-five families afflicted with this disease have been reported and it is this hereditary feature which distinguishes it from multiple hemangiomatosis (O'Kane).

The telangiectatic areas appear as tiny, red-dish-purple spots 1 to 3 millimeters in diameter (Figs 20, 21). On microscopic examination they consist of extremely thin, dilated venules and capillaries lined with a delicate layer of endothelial cells. Unlike hemophilia, the disease is transmitted by both sexes, and the bleeding and clotting times are normal. The disease may manifest itself at any age, but the onset is most common during the fourth or fifth decades of life. Hemorrhage, which may be persistent and alarming, is fatal in only 4 per cent of the cases. One of our patients died as a result of gastric hemorrhage.



Fig 14, left G V Racemose type of hemangioma. A soft, bluish, cavernous, pulsating, compressible mass involving the entire left face and bulging into the oral cavity. The patient is a 60 year old male. The onset of the condition was at the age of 20.

Fig 15 The lesion was surgically ligated and injected with sodium morrhuate on many occasions with satisfactory control.

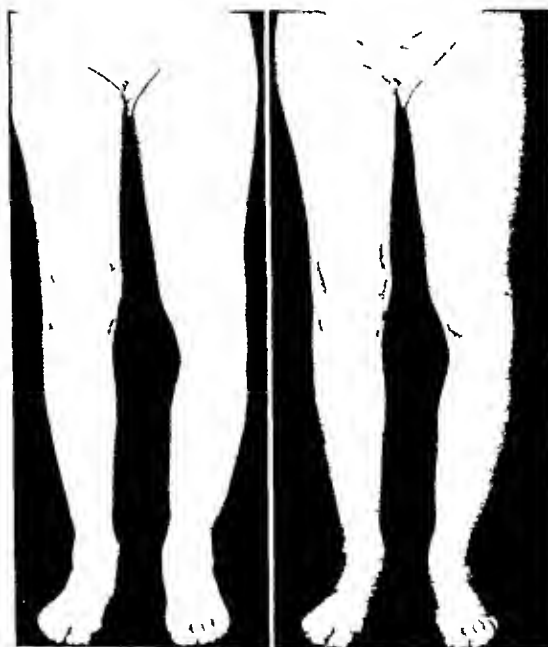


Fig 16, left E B Diffuse systemic hemangioma of entire left leg. The left leg is slightly longer and slightly larger than the right and is faint bluish and of spongy consistency. The patient is a 14 year old girl. The condition was noted at birth and has progressed very slowly. Patient had a right nephrectomy recently for perinephal angioma of kidney.

Fig 17 Infra red photograph. Note the superficial blood vessels in left leg.





Fig. 8. W.S. Nevus venosus or port wine stain of face. Not the thin, alled, scattered, superficial, telangiectatic vessels like this adult endothelioma.  $\times 75$ .



Fig. 9. G.W. Nevus venosus or port wine stain of face. Eight month old male infant. The lesion, as present at birth. No growth. It is characteristically bright purplish red, flat, and blanches poorly with pressure. It ends abruptly at the midline.

Death usually results from intercurrent infections which these anemic individuals cannot combat.

In this series of 9 cases there was no sex predilection, but there was a majority of Polish Jews. In all cases the nasal or oral mucosa was involved and several had definite telangiectatic spots in the skin of the face and fingers. Two apparently suffered with gastric lesions as evidenced by repeated hematemesis. In 4 cases the onset was noted in childhood.

#### THERAPY

The clinical and pathological classification of hemangioma enumerated forms a basis for the following clinical study of the various therapeutic measures carried out in the attempt to bring about a cosmetically acceptable regression of the tumor.

**Carbon dioxide snow.** Carbon dioxide snow therapy yields satisfactory results in the management of the superficial, capillary lesions and is also useful in clearing the residual mot

ted areas remaining after sodium morrhuate therapy. The solid carbon dioxide snow is broken into small blocks and fashioned into suitable shapes. If the block is held in the fingers with gauze and pressed tightly against the lesion for from 7 to 10 seconds, the lesion may be obliterated without scarring. Several applications at intervals of 2 to 3 weeks are usually necessary.

The subfreezing temperature of the blocks is transmitted to the tissue and infuses the endothelial cells causing thrombosis and fibrosis. Since penetration extends but a few millimeters into the tissue only the flatter lesions can be treated in this way. Capillary lesions of a large surface area should be segmented and treated with several applications. Superficial ulceration results if applications are continued longer than 15 seconds.

**Sodium morrhuate therapy.** With the exception of the superficial capillary lesions and large inaccessible tumors, sodium morrhuate therapy is now the method of choice at Memorial Hospital. We have experimented with injections of many different sclerosing solutions and even boiling water, alcohol, and ferric chloride have been tried but a 5 per cent solution of sodium morrhuate has been



Figs 20 and 21. D.H. Hereditary hemorrhagic telangiectasia or Rendu-Osler-Weber disease. Characteristic minute purplish areas of telangiectasia in the mucous membranes of the nose, tongue and lips. The patient is a 47 year old female with a history of repeated epistaxis and hematemesis for years. There is a definite familial history.

found to be ideal and is now the only sclerosing solution used at our hospital for the treatment of hemangiomas. This solution has been used with increasing frequency since it was first employed by us for this purpose in 1935.

Sodium morrhuate has an advantage over quinine and urethane and other sclerosing agents in that it does not cause painful necrosis when accidentally injected into normal tissues. No phenomena of allergy or embolism has occurred in several thousand injections in children. One instance of sensitivity occurred in an adult.

The technique of injection is simple. A long hypodermic needle is introduced directly into the hemangioma mass. The amount of the solution injected varies, but, on the average, from  $\frac{1}{4}$  to 3 cubic centimeters is used depending on the size of the lesion. If blood can be withdrawn into the syringe the entire amount is injected into that area, otherwise the solution is injected diffusely throughout the lesion. Compression is applied immediately and is maintained for 5 minutes. At intervals of from 2 to 5 weeks injections are repeated.

The action of the injected sodium morrhuate is to cause thrombosis and this is followed by sclerosis, atrophy, and absorption of the vessels. In order to be effective the agent does not necessarily need to come in contact with the vessel lining. In capillary hemangiomas the vessel lumen is too small and the stroma too abundant for sodium morrhuate to be efficiently injected.



Fig 22, left. K.O. Early racemose type of hemangioma successfully treated with sodium morrhuate injections. Mound like, soft, bluish, pulsating mass 3 centimeters in diameter situated in the subcutaneous tissue of the face of a 5 month old child.

Fig 23. Result 2 years later. Complete regression following 2 injections of sodium morrhuate.

The racemose, muscle, and large aggressive cavernous hemangiomas of the skin also resist this form of therapy because the fast flowing blood stream tends to sweep the solution out of the large sinuses before sclerosis or thrombosis can be effected. This can be prevented to some extent, however, by maintaining compression during and immediately after the injection of the solution.

The treatment is most strikingly effective with simple cavernous hemangiomas and stellate hemangiomas. The latter usually respond to a single injection of a few drops of the agent into the central arteriole.

Gratifying results are also to be had in the treatment of telangiectatic spots of Rendu-Osler-Weber disease. However, in this particular type of hemangioma the injection should be made in the submucosa alongside the telangiectatic area rather than directly into it, so that the solution will diffuse into the vessels. Injection directly into the vessel lumen invariably precipitates a hemorrhage. The treated area should be adequately compressed for several hours following an injection. New lesions should also be treated prophylactically before they start to bleed.

The typical large aggressive cavernous hemangiomas should be injected at intervals of from 5 to 7 days. If growth continues after 2 or 3 injections, the insertion of gold radon seeds should be begun immediately.

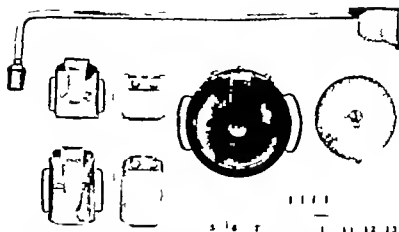


Fig. 24. Radon applicators used in the treatment of angiomas. Unfiltered radon both with long handle. Brass plaques for radon capsules. With containers arranged to the left container rests on centimeter wooden block. The square plaque threshold erythema dose of 5 milligram hours. Long plaque, threshold erythema dose of 50 milligram hours. Round plaque threshold erythema dose of 350 milligram hours. Four gold radon seeds are shown above the scale.

Two patients with early pulsating racemose hemangiomas were successfully treated with sodium morrhuate injections alone (Figs. 22-23). More frequently this method of treatment must be supplemented by radiation therapy and surgical ligation of contributory vessels, or even common carotid artery ligation. In 5 of the 7 remaining cases in our series, the lesions were controlled by a combination of surgery, interstitial radon and sodium morrhuate injections. 1 patient died of hemorrhage and the other died as a result of tumor encroachment on the food and air passageway. In making the injection of sodium morrhuate into a racemose hemangioma, blood is withdrawn into the syringe and from 3 to 5 cubic centimeters of solution is discharged into the lumen of the vessel. Compression may be applied both during and after the injection.

**Radiation therapy.** Therapy by radiation may be administered externally with x-rays or radium. In either case the effect of radiation is directly on the vessel endothelial cells and causes obliteration followed by eventual sclerosis. If radium element or radon is employed all  $\beta$  radiation should be eliminated by proper filtration in order to prevent undue skin damage. Capsules containing radon are used at Memorial Hospital and are employed

in square long and round brass plaques (Fig. 24) giving a filtration equivalent of three millimeters of brass. The applicator is held in a container on top of a wooden block which maintains it at a constant distance of 1 centimeter from the skin. The containers are easily taped to the skin with adhesive. These brass applicators find their chief use in the treatment of capillary hemangiomas which are too thick for carbon dioxide snow therapy and also superficial small cavernous hemangiomas which resist sodium morrhuate therapy.

The group of 388 patients treated with the brass radon plaque alone constituted the largest group in the series. Careful analysis of the results of such therapy indicate that with the factors employed the optimum dosage for most hemangiomas is from 1 to 2 threshold erythema doses. When a dose of over 2.5 threshold erythema doses was used radiation fibrosis and telangiectasia often resulted. Many patients received 2 applications within 3 months with only fair results. It was later concluded that regression after application of the plaque did not start for several weeks and that it continued for 6 months or more. It was obvious, therefore, that these growths had been overtreated. To obviate cumulative overdosage during such a characteristically long

regression period, only 1 application of between 1 to 2 threshold erythema doses should be given. A fraction of this dose may be repeated after 8 or 10 months, unless growth continues after the initial dose. In the latter instance, a second, smaller dose may be applied within 6 weeks.

Another type of radon radiation is administered with the "radon bulb" (Fig 24). The equipment consists of a small radon filled glass bulb on the end of a long applicator. The glass bulb, 4 millimeters in diameter, has no filtration and, therefore, emits both  $\beta$  and  $\gamma$  rays. It is particularly useful in treating resistant superficial capillary lesions. A dose of from 30 to 100 millicurie minutes will often be sufficient to bring about a good regression. In 1 case of hemangioma of the vocal cord, the bulb was applied to the lesion for a few seconds through a laryngoscope with excellent regression.

For interstitial irradiation of angiomatous masses, we use small, radon-filled, hollow gold seeds 4 millimeters in length (Fig 24) inserted through the bore of special needles. These gold seeds contain 0.5 to 1.5 millicuries of radon and are inserted well below the surface of the tumor and at least 2 centimeters apart. They are reserved for the most resistant hemangiomas and are especially well adapted for use in thick, bulky capillary or cavernous hemangiomas which require skin damaging doses of external radiation. Gold radon seeds should be employed immediately with rapidly growing hemangiomas which resist sodium morrhuate therapy and may also be used as an adjunct in treating the racemose angiomata. The size of the lesion determines the amount of radon necessary for its control.

The end-results obtained with high and low voltage roentgen-rays were disappointing. High, medium, and low voltage were used with varying factors, but many hemangiomas responded only fairly well. Numerous other observers feel that  $\gamma$ -radiation exerts a more marked effect on blood vessel endothelium and for that reason radium has the advantage over roentgen rays. If x-ray therapy is to be used it should be well filtered, low voltage radiation given at a skin target distance of less than 30 centimeters. One to one and a

half threshold erythema doses may be given and if need be followed by a smaller dose when initial primary regression has ceased.

High voltage roentgen therapy seems to be ideal for the treatment of bone hemangioma. The growths in 3 patients with hemangioma of the lumbar vertebræ and 1 with hemangioma of the mandible were permanently controlled, and the patients were relieved of their symptoms by fractionated doses of x-ray. Treatment in all cases was given with the following factors: 200 kilovolts, 30 milliamperes, 50 centimeter target skin distance, and 0.5 millimeter copper and 2 millimeter aluminum filtration delivering 200 r daily through small portals of less than 100 square centimeters. The total dose should be large enough to sclerose the angioma vessels but not large enough to inhibit bone repair. The average satisfactory total dose will usually be 1,200 to 1,600 r per portal. Bone healing is evident in check-up roentgenograms by an increase in density and thickness of the bony trabeculae.

Ray maintains that large cavernous hemangiomas of liver can also be caused to regress with high voltage roentgen-ray therapy. High voltage x-ray is likewise indicated and highly successful in the treatment of hemangiomas of joints and synovia—lesions which can rarely be treated surgically without danger of infection or ankylosis (Bennett and Cobey). It is also indicated in inoperable extensive muscle angiomata and certain racemose hemangiomas.

There is no successful therapy for the metastasizing hemangioma, and palliative radiation alone is indicated.

For some years it has been noted at Memorial Hospital that hemangiomas are more sensitive to radiation and other forms of therapy in the early months of infancy. Evidence tending to confirm this observation was derived by analyzing a special group of cases in which treatment was administered by a single dose of radon with the square plaque. By this selection of cases, many confusing variables were eliminated. As shown in Table II, it was found that a higher percentage of good regressions was obtained in infants under 3 months of age and a definite decrease in the percentage of good regressions in patients



Fig. 5, left. W. L. Spontaneous regression of cutaneous hemangioma of arm. One month old child with bulky bluish compressible hemangioma measuring 6 by 6 by 3 centimeters in the skin of the arm.

Fig. 26. Result 8 months later following spontaneous regression without treatment of any kind.

over 6 months of age. On the basis of these findings we have come to the conclusion that, in general, the radiosensitivity of hemangiomas varies in inverse proportion to the age of the patient. This fact should be called to the attention of our pediatric colleagues as a plea for early treatment.

At this point a word of warning regarding indiscriminate radiation therapy seems indicated. A series of cases as large as the present one is apt to uncover a number of contraindications to this form of therapy and poor results and treatment hazards are found which may surprise even those physicians experienced in this work. This is especially true if a satisfactory follow-up system of control is practised and the patients closely followed not only during treatment but during the healing stage and for years afterward. Clinics without an adequate follow-up system report exceptionally good results and practically no complications or late sequelae.

A study of results seems to indicate that radiation measures are hazardous and should be used with considerable caution in the treatment of hemangiomas in the following locations: (1) scalp where radiation alopecia may result; (2) midline areas over the sternum or vertebrae where ulceration results with even small doses; (3) breasts and genitalia where marked atrophy may occur; (4) long bones, particularly over the epiphyses, where premature ossification may occur leading to arrest of longitudinal growth; (5) areas, such as lips and vulva where irritation is constant and radiation carcinoma may result; (6) areas adjacent to the eyes. In 7 of our cases there is ophthalmological evidence of early radiation

TABLE III—BLOOD AND LYMPH VESSEL TUMORS—HEMANGIOMA—RESULTS OF TREATMENT

	Lesions treated No. of cases	
Excision—surgical or electrical		
Good	23	94
Fair	7	28
Poor		
Indeterminate		
Total	91	
Carbon dioxide snow		
Good	34	38
Fair	6	10
Poor		
Indeterminate		
Total	70	
Sodium morrhuate		
Good	65	70
Fair	4	
Poor	1	1
Indeterminate	10	
Total	70	
Combined physical—sodium morrhuate and snow		
Good	30	34
Fair	3	9
Poor		
Indeterminate	6	5
Total	4	
Combined radiation and physical		
Good	78	83
Fair	30	5
Poor		10
Indeterminate	9	
Total	70	
External radiation—radium		
Good	8	6
Fair	3	1
Poor	13	16
Indeterminate	11	
Total	35	
Interstitial radiation		
Good	80	90
Fair	47	12
Poor	3	9
Indeterminate		
Total	5	
X radiation		
Good	3	45
Fair	0	
Poor	8	30
Indeterminate	7	
Total	34	
Combination radiation—external and interstitial		
Good	31	57
Fair		33
Poor	6	10
Indeterminate		
Total	40	
No treatment	0	
*Spontaneous regression	3	
Refused treatment	3	

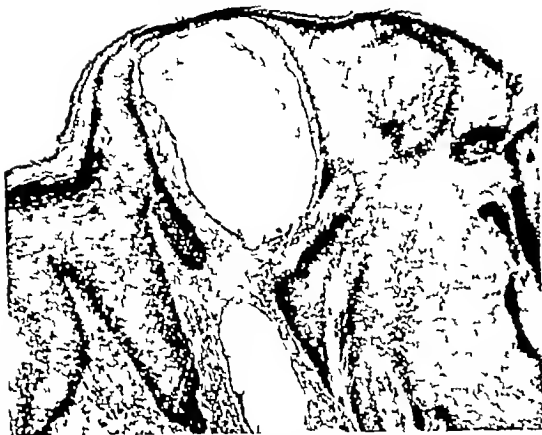


Fig 27 Simple lymphangioma of skin Section of typical thin walled, endothelium lined, bleb like structure which appears as purplish red skin vesicles  $\times 75$



Fig 28 FR Cavernous lymphangioma of tongue Note large sinuses lined with single layer of endothelium containing lymph and invading and destroying muscle bundles  $\times 75$

changes in the lens. Fortunately, vision has not been impaired in any of the patients as yet and the changes would not have been detected unless a trained ophthalmologist regularly examined these children.

Radiation lens changes usually occur within 2 to 5 years and are readily detected by the characteristic ophthalmoscopic appearance of a small central, circumscribed, flake-like opacity in the lens capsule. It cannot be urged too strongly that in all the areas mentioned, and particularly in hemangiomas about the eyes, the possibilities of the carbon dioxide snow and sodium morrhuate injection therapy should be fully exhausted before radiation is used.

**Surgical excision** Because it must necessarily be wide to obviate recurrence, surgical excision very often leaves unsightly scars. This, coupled with the discovery that in our series many individuals with angiomas have a tendency to form postoperative keloids, has placed the method in some disfavor. The group, presented under such a heading therefore, is a highly select group and the favorable results are misleading. Surgical excision is indicated for the small papillary tumors, bulky capillary lesions in areas where scars may be concealed by clothing and the resistant angiolipomas and for angiofibromas. Its main use is with the bulky "hemangioma hypertrophicum" where multiple stage excisions

may be necessary (Figs 11, 12). These lesions are too cellular for injection therapy and too thick and aggressive for radiation measures.

Surgical excision is likewise the method of choice in the treatment of muscle hemangiomas (Jenkins and Delaney). Most of these growths have no capsule, and excision must be quite wide of tumor. Six of the 10 patients in this series were successfully treated by excision. In the 2 remaining successful cases treatment was by radiation alone at the ex-



Fig 29, left Cavernous lymphangioma of thigh Male patient aged 12 years. Lesion present at birth. Recurred after excision. A bulky, spongy, compressible mass 25 by 15 by 8 centimeters with typical purplish red skin vesicles.

Fig 30 Result 3 years later following radiation and excision.

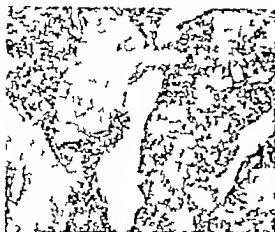


Fig. 3. M.S. Hypertrophic or cellular type of lymphangioma. Large lymph-filled sinuses surrounded by masses of proliferating endothelial cells. Lesion noted deep in the dermis of 40-year-old female as large encapsulated, well-circumscribed, yellowish mass. Extension occurred after excision.  $\times 75$ .

pense of some skin damage. Surgical excision is the only method worth considering in the treatment of hemangiomas of the gastrointestinal tract (Brown).

Ligations of the afferent vessels supplemented by sodium morrhuate injections and in severe cases various radiation measures are to be considered for the diffuse systemic type of hemangioma. The results are disappointing.

Port wine stains do not respond well to radiation, carbon dioxide snow or injections of sodium morrhuate solution. Upon reviewing the microscopic section (Fig. 18) the reason for such radioresistance is evident since the telangiectatic scattered vessels possess a thin flattened vessel endothelium of adult type as contrasted with the thick celled endothelium of the sensitive embryonic type. There is no evidence of endothelial proliferation whatsoever and, like most static lesions, the port wine stain is consistent in its therapeutic resistance. Small lesions may be excised, but larger lesions can be improved cosmetically only by covering them with proprietary cosmetic paste such as Covermark.

Occasionally a hemangioma may regress spontaneously, usually following ulceration or infection. Three remarkable spontaneous regressions occurred in this series. Such regressions may be explainable by chance



Fig. 4 (left). Diffuse systemic hemolymphangioma of 17-month-old child with diffuse mottled bluish, compressible lesions of entire leg. Not unusual lymphangioma skin rashes associated with deep crural hemangioma. Similar angioma (over process noted in sigmoid at operation).

Fig. 5. Photograph 6 years later following course of roentgen therapy and sodium morrhuate injections.

thrombosis of the tenuous afferent vessel. In all of these cases the regression was complete in a few months (Figs. 25, 26).

#### RESULTS OF THERAPY

In every case in this series the treatment has been analyzed and critically appraised. Cases in which therapy was not finished or in which the records were incomplete are considered indeterminate and are not included in the figures.

The various therapeutic methods employed are listed in 10 categories (Table III). Most of the headings are self-explanatory but a word should perhaps be said about several of the later divisions. External radon radiation applies only to brass plaques containing radon-capsules and radium bulb applications.

Interstitial radiation refers to the lesions in which gold radon seeds were inserted into the substance of the tumor. X-radiation includes high, medium and low voltage roentgen therapy. Combination radiation applies to all combinations of external radium with roentgen and interstitial radiation.



Fig 34



Fig 35

Fig 34 G.H. Cystic hygroma of the neck. Two month old female. Lesion present at birth. Successfully excised.  
 Fig 35 Gross specimen 6 centimeters in diameter with attached skin.



Fig 36

Fig 36 Cut section showing multiloculated, thin walled cysts containing clear serous fluid. Examination of the specimen showed that all of the locules were in communication with one another.

The effectiveness of therapy was judged "good," "fair," or "poor," according to the cosmetic results obtained and the regression of the lesion. The term "poor" is applied, in addition, to all cases in which there were recurrences or complications.

In looking over the chart giving the results of therapy, it will be seen that the lesions excised surgically show the highest percentage of good results (91 per cent), but, as noted earlier in the discussion, this is a highly select group of cases. Postoperative keloid formation accounts for most of the unfavorable results in this group.

The results of the carbon dioxide snow treatment were also impressive, 88 per cent of the cases showed good response. The unfavorable results invariably followed too long an application with consequent ulceration and scarring.

Being our method of choice, sodium morrhuate injections are given a trial for the first few weeks in all types of hemangiomas, including even the capillary type. Rapidly growing lesions which do not respond to 2 or 3 injections should be subjected immediately to radiation or surgical intervention regardless of the location of the tumor. Results were good in 86 per cent of all the cases treated with sodium morrhuate. Improper selection or over-injection accounts for the less favorable results.

The "combined physical" group yielded 86 per cent good results. Generally, sodium

morrhuate was the primary agent, and carbon dioxide snow was used later to eradicate the residual skin mottling.

A sharp drop in the percentage of satisfactory results is noted in the group of cases in which radiation was employed. This is to be expected since radiation is reserved for the more extensive and the more resistant lesions. In some cases, however, over-irradiation resulted in telangiectasia or fibrosis.



Fig 37 A.B. Cystic hygroma of neck. Note muscle bundles in center of field, circumscribed on both sides by invading thick walled endothelial lined cysts. Lesion present at birth in the posterior neck of a one year old child. Slow growth. Excised successfully.  $\times 65$





Fig. 38, left. R.G. Cystic hygroma of neck. Six-week-old infant. Fifth soft cystic hygroma 3 centimeters in diameter in the posterior triangle of the neck. It was noted at birth. Growth was slow. Serum fluid aspirated and two injections of sodium ascorbate administered.

Fig. 39. One year later showing complete regression. No recurrence at the present time, 3 years later.

The "combined radiation and physical therapeutic measures were employed in an aggressive group of hemangiomas which successfully resisted the physical agents, usually sodium morphuate. Good results here were excusably lower (65 per cent). Nevertheless in many cases the injections helped to the extent of causing some sclerosis, thereby reducing the supplementary radiation dose necessary for complete regression.

The figures for external radon radiation include the group of cases which received single doses of irradiation and those which were given divided doses. The results of the combined techniques were good in 6 per cent of the cases. Breaking down this figure it was found that the single dose technique yielded over 80 per cent good results and that the combined percentage was lowered chiefly by the poorer results obtained when multiple doses were employed. Invariably the second dose had been given before a 2 month interval had elapsed and thus was prematurely given in so far as the primary regression had not ceased. It was decided therefore that cumulative overdosage was responsible for the unfavorable results.

Good results were obtained in only 59 per cent of the patients who were treated by interstitial radon gold seed radiation. The results are better than the figures would seem

to indicate however for the hemangiomas treated by this method were either the aggressive cellular lesion or the extensive deep cavernous ones.

The group treated by x radiation responded least favorably. Good results were obtained in only 48 per cent of the cases. Poor results were higher than in any of the other methods of therapy—30 per cent of the series. This unfavorable response can be explained by several factors. First most of the lesions were the refractory diffuse systemic type which respond poorly to any form of treatment. Second filtration was probably inadequate in some cases and undoubtedly there was overdosage in others. There is little doubt that hemangiomas respond less favorably to roentgen rays than to the harder  $\gamma$ -rays of radium or radon.

Results of the "combined radiation series were good in 57 per cent of the cases. This is an acceptable figure when it is considered that only the aggressive, extensive lesions were treated by this method of therapy.

"Spontaneous regression" without ulceration occurred in 3 cases and in 1 instance the regression was quite spectacular. Since there is no way however of knowing which tumors will spontaneously regress, all should be treated and, if possible treatment should start immediately after onset. Untreated lesions often ulcerate and bleed but even when they do not the growths steadily become more resistant to therapy and are more likely to recur after treatment.

#### RECURRENCES

Forty three patients, roughly 4 per cent of our series, had recurrences after treatment either at Memorial Hospital or elsewhere and most of the recurrences took place after surgery. Practically all the patients with recurrences were adults with long standing lesions.

#### LYMPHANGIOMA

Lymphangiomas like hemangiomas, may possess marked growth capacity and they are not as was once commonly supposed dilated static, normal lymph channels. Some observers state that lymphangiomas have no anastomoses with surrounding lymph vessels.

It is generally agreed that lymphangiomas have their origin in displaced fetal cells of the lymphatic system

A group of 41 cases of lymphangioma comprises the material studied in this report. Sixty-one per cent of the patients had the tumor at birth and 95 per cent were noted before the age of 10 years. Sex distribution was almost equal, the female percentage, 58 per cent, being only slightly higher than the male.

The anatomical distribution was considerably different from that of the hemangiomas. Fifty-two per cent of the lymphangiomas were located on the head and neck, 44 per cent on the extremities, and 4 per cent on the trunk.

#### CLASSIFICATION

Wegner's original classification of lymphangiomas as simple, cavernous, and cystic, is commonly accepted. In order that the classification be completely satisfactory in a clinicopathological consideration of lymphangiomas, however, several additions must be made. In the present study, the classification has been enlarged to the following five divisions: (1) simple lymphangioma, (2) cavernous lymphangioma, (3) cellular or hypertrophic lymphangioma, (4) diffuse systemic lymphangioma, and (5) cystic lymphangioma or hygroma.

1 *The simple lymphangioma* (Fig 27) is an uncommon, poorly defined disease entity which borders on simple lymphangiectasia. Its channels are superficial, scattered, and thin walled. The lesions are small, well circumscribed, and present a shiny wart-like surface. They show little tendency to grow.

2 *The cavernous lymphangioma* (Figs 28, 29, 30) usually constitutes the majority of lymphangioma cases. This form is composed of dilated lymphatic sinuses usually filled with lymph, but sometimes empty, and in rare instances filled with blood. The lining endothelium is flat, and in active lesions may be several layers in thickness. The stroma varies in amount and may be found to contain diffuse lymphoid or smooth muscle tissue, attesting to the embryonic origin of the tumor from mesodermal "rests." A mixed form with fat or fibromatous elements also exists. Solid

endothelial "buds" can frequently be seen invading surrounding fat and muscle.

A cavernous lymphangioma usually involves skin or subcutaneous tissues, but it may extend into mucous membranes of the oral cavity or between the muscle septa of the neck. The superficial skin lesions appear as multiple brownish or red vesicopapules, or even wart-like papillary lesions which exude lymph when traumatized. The deeper growths present an appearance of multiple, diffuse, compressible nodules or masses with little or no change in the overlying skin. This growth occurs commonly about the face and in the oral cavity. Involving the tongue, it produces great hypertrophy—macroglossia, in the lips it is known as macrocheilia, and in the cheek as macromala. Other sites are the extremities and the retroperitoneal and mesenteric areas.

3 *The cellular or hypertrophic lymphangioma* (Fig 31) is simply a more active type of local cavernous lymphangioma and has a minimum of sinuses and an abundance of proliferating endothelium. It is slow growing and uncommon. Clinically, it appears as a circumscribed, superficial structure of fibrous consistency.

4 *The diffuse systemic lymphangioma* (Figs 32, 33) generally involves an entire extremity. The process is slow and may continue for many years. Clinically, the extremity appears hypertrophied and overstuffed. The skin may be normal or studded with papules. The deeper tissues have a spongy consistency. Microscopically, the lesion is generally found to be cavernous, but it is more active than the simple cavernous type. Frequently, the channels contain blood, and the tumor may simulate a cavernous hemangioma, but clinically its behavior is that of a lymphangioma. Also, the vesicopapules have a bluish hemorrhagic hue, whereas hemangiomas are not associated with such bleb-like structures.

5 *Cystic hygroma or the cystic type of lymphangioma* is a distinct disease entity and must not be considered merely as a dilated or cystic cavernous lymphangioma. The tumor definitely develops from lymphatic tissue, and for this reason is included in our classification.

Hygromas are usually found in the neck, but occasionally they are located in the axilla,

and, in rare instances, in the retroperitoneal tissues (Gerster) or in the groin. The cystic mass is compressible thin walled and generally multiloculated (Figs. 34-37). It is lined with endothelium and contains serous fluid. The lesion usually transilluminates well, thus making it possible to distinguish a hygroma from other cystic masses occurring in the neck, such as a branchogenic cyst.

Hygromas are generally present at birth and grow very rapidly. In the neck the growth often extends into the axilla or down into the mediastinum causing symptoms of compression. The remarkable power of growth which these cysts possess may be attributed to their origin from the same primitive jugular sacs (McClure and Silvester) or initiation centers from which the lymphatic system develops. Two such jugular sacs are situated in the neck adjacent to the internal jugular vein, 1 in the lumbar retroperitoneal area and 2 in the iliac area. These locations correspond exactly with the anatomical sites at which hygromas are usually found. The process by which hygromas develop was not well understood until Goetsch demonstrated that solid endothelial sprouts extend into surrounding tissue, encircle vital structures, secrete lymph, and canalize back to the parent cyst.

Two hundred and twenty five cases of hygroma have been reported in the literature. The Memorial Hospital series includes 14 cases, an incidence of 1.4 per cent of the total number of blood and lymph vessel tumors reviewed in the present study. Nine of the patients were male and 1 was a Negro. In 11 cases, or 79 per cent the cyst was present at birth and the remaining lesions developed at the ages of 4, 6 and 15 years.

The anatomical distribution of the lesions supports the lymph-sac theory of origin. Thirteen or 93 per cent, of the lesions were located in the neck and the other was situated in the axilla. This fact is particularly interesting when it is remembered that only 2 per cent of all other types of lymphangiomas were located in the neck. In 2 of our cases, roentgenograms of the chest were made and revealed mediastinal shadows suggesting disease extension into that area.

#### TREATMENT OF LYMPHANGIOMA

In general, surgical excision affords the best prognosis in the treatment of lymphangiomas even though unsightly scars are likely to form and there is a marked tendency toward post-operative keloid growth. The results were good in 77 per cent of the 13 patients in our series in which wide excision was performed. In 4 of the cases there was a definite recurrence which was controlled by a second excision. Routine postoperative radiation is helpful in controlling recurrences and in preventing keloid formation. If surgical excision must be incomplete a fairly large dose of interstitial radon is necessary for control of the irremovable portion.

Lymphangiomas are radioresistant and for this reason radiation therapy alone is not usually indicated. With but one exception, all cases in which treatment was by radiation, a dose was required which caused marked skin damage. Good results were obtained in only 35 per cent of the 18 cases in which radiation treatment was used, and in 25 per cent the results were definitely poor.

Because of the nature of the disease, radiation remains the method of choice however in treating the diffuse systemic lymphangiomas which affect an entire extremity. High voltage therapy is generally used at 50 centimeter target skin distance with high filtration.

Sodium morrhuate injections have no effect whatsoever in the treatment of lymphangiomas, with the exception of cystic hygroma.

Lymphangiomas show a marked tendency to recur. Seventeen or 41 per cent of our cases, were recurrences after treatment elsewhere. Our own recurrence rate was 12 per cent. Most of these were cases of surgical excision. An analysis of our records show that, as with hemangiomas, this tendency toward recurrence increases with the age of the patient (Table IV).

Cystic lymphangiomas (hygromas) are relatively radioresistant. Regardless of the method of treatment, the results are often not satisfactory and the general mortality rate is high. Secondary infection of the hygomatous mass may follow an upper respiratory infection and lead to an acute toxemia or septic-

TABLE IV — BLOOD AND LYMPH VESSEL TUMORS  
— ANALYSIS OF RECURRENCES

Number of cases with recurrence			
Hemangioma			43 <sup>1</sup>
Lymphangioma			17 <sup>2</sup>
Hygroma			1 <sup>3</sup>
Total			61
	Cases	Percent of entire age group	Cases in age group
Hemangioma			
Age incidence of recurrence			
Under 1 year	3	0.5	565
Between 1 and 10 years	13	7	195
Between 10 and 20 years	9	17	53
Over 20 years	18	10	188
Lymphangioma <sup>4</sup>			
Under 1 year	0	0	4
Between 1 and 10 years	4	25	16
Between 10 and 20 years	7	58	12
Over 20 years	6	66	9
Hygroma			
Following sodium morrhuate therapy	1		
<sup>1</sup> 14 percent of all hemangiomas			
<sup>2</sup> 41 percent of all lymphangiomas			
<sup>3</sup> 7 percent of all hygromas			
<sup>4</sup> Extinction or recurrence after treatment elsewhere 17 or 41 percent recurrence after treatment at Memorial Hospital 4 or 10 per cent.			

mia This is particularly true of the cervical hygromas which are located in the area into which infections of the nasopharynx, the pharynx, and the tonsils normally drain. It is also noteworthy that postoperative infections frequently occur, due, no doubt, to a derangement of the lymphatic barriers.

In a review of the 126 cases, Dowd noted a mortality of 47 per cent in the cases of cervical hygroma treated by surgical procedures of various kinds. Figs, of the Mayo Clinic, reported 13 patients treated by radiation alone, of these 7, or 54 per cent, died of infection during treatment.

Of the 13 cases in our series, surgical excision was performed in 7 with a good result in 5. In 1 case of axillary hygroma, the lesion was not completely removed because of the extent of the tumor. The remaining case was an unusually large cervical hygroma which extended into the mediastinum, this patient died soon after operation, thus making the operative mortality 7 per cent.

Because of the ever present danger of postoperative infection, we have striven to institute a more conservative form of therapy. Following Harrower's suggestion, in 7 of our

cases we routinely aspirated the hygroma under the strictest sterile precautions and injected from 1 to 3 cubic centimeters of a 5 per cent sodium morrhuate solution. Four cases, 57 per cent, showed good results (Figs 38, 39), but in 2 cases regression was only fair and excision was necessary. In the remaining case, gold filtered radon seed implantation was required to complete the regression.

In the cases in which we have had an opportunity to try it, we believe the results justify the recommendation that sodium morrhuate therapy be given a trial in the treatment of all hygromas. If it fails, one must attempt surgical excision and if excision is necessarily incomplete then radiation measures may be attempted. Injections should be given as early in the course of the disease as possible for the following reasons: (1) hygromas are more sensitive to therapy and are more likely to be unilocular early in the course of the disease, (2) while Goetsch suggests postponement for several months until the patient is a better surgical risk, it should be remembered that the earlier the cyst is treated the less opportunity there is for it to invade and circumscribe vital structures, (3) with sodium morrhuate therapy there is not the high mortality associated with surgery or radiation, (4) postponement increases the danger of mortality from secondary respiratory infections.

#### SUMMARY

1 A comparative clinical, pathological, and therapeutic study of 1,056 patients with 1,363 individual blood and lymph vessel tumors is reported.

2 Benign tumors of blood and lymph vessels have a common origin in embryonic sequestrations of mesoderm, grow in identical fashion, demonstrate similarities in response to various therapeutic agents and, therefore, are studied as a single group.

3 A suggested classification of blood and lymph vessel tumors is based on the clinical and pathological aspects of these lesions in so far as they serve the dictates of therapy.

4 Methods of therapy are appraised and their indications and hazards pointed out. Evidence is offered to support the contention

that hemangioma is more sensitive to radiation in the first 3 months of life and that angiomata in general recur less frequently when treated early.

5 A conservative method of treating *hygroma* is advocated and outlined. Injection therapy immediately at onset is urged in order to afford the tumor less opportunity to circumscribe vital structures and also to obviate the danger of upper respiratory infections draining into the tumor and possibly causing death. Surgical excision with its high mortality is recommended after the conservative method has failed. Radiation therapy is recommended for inaccessible extensions of the hygroma.

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# ACUTE INTESTINAL OBSTRUCTION

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**N**OTWITHSTANDING the improvements made in surgical technique and the additions made to the therapeutic armamentarium for the treatment of acute intestinal obstruction, the mortality in this feared condition has not been materially reduced. Once the symptoms and signs suggestive of interruption of continuity of the intestinal lumen are present, a rapid and accurate diagnosis should be made, thus permitting the institution of the proper form of treatment. An investigation has been made of all cases of acute intestinal obstruction in which surgical treatment has been given at the Mayo Clinic, over a period of 5 years, to determine the various etiological factors and the relationship of treatment to mortality.

Excellent classifications of the different causes of acute mechanical obstruction of the intestine have been presented by many authors. A recapitulation of the causes of obstruction reviewed in the present series will be found in Table I. It should be noted that some of the congenital etiological agents do not appear in this collection of cases.

Incarcerated or strangulated external hernias are the most frequent cause of acute intestinal obstruction. These may be divided anatomically into inguinal, both indirect and direct, femoral, umbilical and ventral, and prolapse through the site of a previous surgical procedure. External hernias accounted for the symptoms in 147, or 44 per cent, of the 335 cases of acute intestinal obstruction reported by McIver (8). In the series reported by Morris and Johnson, 129 instances, or approximately 54 per cent, of the same syndrome were caused by external hernias. Four per cent of all patients having hernia, admitted for treatment in a period of 13 years were found to have an associated intestinal obstruction. Various types of external hernia-

tions accounted for 74, or 53 per cent, cases of acute interruption of intestinal continuity seen at the clinic from 1935 to 1939, inclusive.

The syndrome presented by external hernias that produce obstruction is characteristic. Abdominal pain, crampy or steady in nature, nausea, vomiting, and constipation associated with an irreducible tender mass, are the cardinal symptoms and signs. Distention is usually mild in degree, and the lower portion of the ileum is the most frequent site of obstruction. Incarceration and strangulation must be sharply distinguished from one another since the treatment and prognosis differ greatly in these 2 conditions. The former may exist for long periods without symptoms. Once the lumen has been encroached on to some degree, or the vascular supply to the region has been interfered with, therapy must be undertaken immediately. Small internal abdominal rings offer a great chance for strangulation. "Reduction *en bloc*" should be sharply criticized for non-viable omentum and intestine may unwittingly be returned into the abdominal cavity. Protrusions of the omentum and incarceration or strangulation of the adipose tissues present an acute picture and it is often difficult to decide whether bowel is present in the sac. Surgical procedures should decide the question. Strangulation has been found to occur more frequently in association with femoral and umbilical hernias than with inguinal protrusions, although the occurrence of the two former types is infrequent as compared with that of the latter.

Marked tenderness over the sac of an irreducible hernia, associated with signs of obstruction, symptoms of toxemia, and an increase in the number of leucocytes, points to strangulation of the bowel. In McIver's (8) series of 147 cases, males were subject to strangulated external hernia about twice as frequently (100) as females (47) were. These statistics are in close accord with the

From the Division of Surgery, the Mayo Clinic.

TABLE I.—CAUSES OF ACUTE INTESTINAL OBSTRUCTION IN CASES ENCOUNTERED AT THE MAYO CLINIC, 1935-1939, INCLUSIVE

	Cases
External hernia	
Indirect inguinal	43
Direct inguinal	3
Indirect and direct inguinal (combined)	6
Umbilical	
Femoral	8
Ventral	
Protrusion through site of previous operation	
Internal hernia	7
Adhesions and bands	3
Volvulus	9
Intussusception	
Mesenteric thrombosis	3
Gall stones	
Congenital mesenteric cysts	
Diverticulitis	
Carcinoma	4
Total	96

present group of 74 patients of whom 54 were males and 20 were females.

Mortality in external strangulated hernia is most intimately associated with the degree of embarrassment of the blood supply to the affected portion of bowel. Some interference with circulation will be present with every such hernia but frequently the bowel will be considered viable on release of the obstruction. The question of viability may be more quickly decided at operation if the patient is given 100 per cent oxygen and the color of the bowel is watched closely. When doubt exists the loop of bowel should be exteriorized. In 42 cases of the total group the viability of the bowel was strongly questioned at the time of operation (Table II). Fortunately the bowel was considered viable in the great majority of patients. Most of the deaths occurred when necrosis of the bowel had occurred thus necessitating procedures other than release of the obstruction and repair of herniation site.

The large number of cases in which it was questionable whether the blood supply to the affected loop of bowel was adequate are readily explained. Special types of acute surgical conditions seen at the clinic are not unlike those encountered in any large medical center inasmuch as the greater number of patients with acute intestinal obstruction owing to hernia are cared for by the local practitioners as emergencies, whereas patients critically ill are sent to the clinic.

TABLE II.—EXTERNAL HERNIAS CAUSING INTESTINAL OBSTRUCTION IN WHICH A SUFFICIENT BLOOD SUPPLY TO LOOP OF BOWEL WAS QUESTIONABLE AT THE TIME OF OPERATION

Type of hernia	Total patients		Admission of and supply questionable	
	Males	Females	Males	Females
Indirect inguinal	4			
Direct inguinal	3			
Indirect and direct				
Umbilical		3		
Femoral		9		7
Ventral	3	3		3
Protrusion				

Internal hernias, by definition should include all of those protrusions of the contents of the abdomen through intraperitoneal pouches or openings of congenital or traumatic origin. The number of such hernias is small in contrast to the external protrusions that take place through the abdominal wall. In reporting a case of prevesical hernia, Stalker and Gray have stated that only 29 internal hernias have been encountered at the Mayo Clinic since 1920. These were classified either anatomically or on the basis of an associated etiological factor as 8 cases of hernia through the transverse mesocolon, following gastro-enterostomy 7 of para-duodenal hernia 4 of mesenteric hernia 3 of malrotation of the colon 3 of hernia through the broad ligament 2 of retrocecal hernia 1 of hernia through the foramen of Winslow and 1 caused by fibrous bands. Twenty-five patients had symptoms referable to the hernia, but these were vague and not diagnostic. Twenty-three had some degree of obstruction of the small intestine.

If this type of hernia did not become manifest through partial or complete interruption of the continuity of the intestinal lumen the majority of such hernias would pass without recognition for they are unheard of until their presence is heralded by some complication such as incarceration volvulus or strangulation. Internal hernias that occur as a result of abdominal operations are now seen less frequently than formerly owing to the taking of proper precautions at the time of such surgical procedures. An example of such a preventive measure is the suturing of the stomach to the opening in the transverse

mesocolon when posterior gastro-enterostomy is performed, to prevent herniation of the small intestine into the lesser peritoneal sac.

Therefore, the more important internal hernias at present are those resulting from congenital defects. Although few in number, these hernias assume considerable clinical significance in consequence of the high incidence of acute intestinal obstruction with which they are associated. Seven patients with internal hernias and acute intestinal obstruction have been seen at the clinic during the 5 year period under consideration. Figure 1 depicts the mechanism of a prevesical hernia recently observed and reported by Stalker and Gray. A rent in the omentum (Fig. 2) was the etiological factor in a second case.

Second only to external hernias as a cause of intestinal obstruction are bands and adhesions. These may be either congenital or the result of inflammation or trauma. Many are very dense in nature. A small portion of the omentum may become attached to the bowel or to the abdominal wall and act as an obstructing band. Likewise, a Meckel's diverticulum may be the etiological factor as in one case in the present series. A fibrous band may be all that is left of the structure, or adhesions may form around the anomaly due to inflammation, with the free end of the diverticulum anchored to the mesentery or to some other structure.

McIver (9) has divided his group of cases of intestinal obstruction, the result of bands and adhesions, into three groups: early postoperative, late after operation, and those without operation. As an etiological factor, McIver (9) found that appendectomy with resultant adhesions heads the list in the early postoperative group. Strangulations are not common among this particular group of intestinal obstructions which usually involve the lower part of the small intestine. However, strangulation is more frequent in the group occurring late after operation and appendicitis is the most common cause.

Twenty-four patients who were suffering from acute intestinal obstruction, the result of bands and adhesions, were seen at the Mayo Clinic during the period under consideration. All but one had been subjected to operation

previously. Twelve had had pelvic operations of various types whereas 6 had had appendectomies performed. It is significant that 6 patients of the total of 24 had some degree of necrosis of the intestinal wall. All patients in this last group had been operated on previously. The jejunum was involved once, different portions of the ileum four times, and a Meckel's diverticulum occurred in 1 instance. All the patients subjected to previous operation experienced obstruction in the late period, that is at least 10 days after operation. The pathological condition present in one such case is shown in Figure 3. In some instances, a period of years had elapsed since the previous surgical procedure. Operative intervention in these cases at the time when the obstruction was treated, varied markedly, depending on the individual circumstances. The surgeon tended to be conservative rather than radical.

Volvulus of various portions of the intestinal tract accounts for only a small number of acute intestinal obstructions. Nine patients comprised this entire group and in marked contrast to other reports, the small intestine was involved more frequently than the large intestine. The jejunum alone was involved once, the ileum alone five times, and both the jejunum and ileum were involved in one case. Ninety-five per cent of the small intestine had become twisted in the remaining case in which the small bowel was involved and the ileocecal region was involved in the last case in the group. Viability of the bowel was so poor in 3 cases that resection had to be undertaken. Bands and adhesions that had fixed some portion of the intestine served as a center for rotation in the majority of cases. With such rotation, an isolated loop which rapidly distends is formed. The vessels are compressed to varying degrees and, with marked embarrassment of the blood supply to the segment, necrosis of the bowel occurs.

Intussusception is essentially a disease of infancy and early childhood. In an interesting summary of 400 cases by Perrin and Lindsay, the authors found that about 65 per cent of the patients were males, and that 78.5 per cent were less than two years of age. Two hundred and three of the 400 patients



had intussusception between the ages of 5 and 9 months. By far the greatest majority of lesions involved the ileocecal region the authors classified 39.0 per cent of their cases as ileocecal and 31.5 per cent ileocolic. The intussusception reached the rectum more frequently in the former group but the distance traveled does not necessarily influence the prognosis too greatly. The chief factor in the determination of mortality is the duration of the intussusception. Death occurred in 34.75 per cent of the 400 cases.

All of the 10 patients in the present series were 2 years of age or less, except 2 who were aged 4 years and 6 years, respectively. Fifty per cent of the patients who had intussusception were between 5 and 10 months of age. Pain in the abdomen vomiting and bloody stools are usually present, and occasionally a rectal mass can be felt.

According to McIver (9) the characteristic picture is not seen in the adult and the diagnosis is often made only at operation. The small intestine is frequently involved and all cases should be investigated for some etiological factor especially when the patient is an adult. In one of the cases in the present group a Meckel's diverticulum was the starting point of the intussusception (Fig. 4).

As one of us (C.W.M.) has pointed out previously treatment of acute intussusception is primarily surgical and reduction of the intussuscepted bowel is possible in less than 24 hours and usually in less than 36. A low mortality is attendant on such a procedure. Immediate resection carries a high mortality. Reduction after 36 hours is dangerous, and consideration should be given to fixation to prevent progression of the intussusception and to ileocolostomy around the affected portion of bowel.

Moore has stated that from available records between 1 and 2 per cent of all intestinal obstructions are the result of gall stones, and he has estimated that about 400 cases had been recorded in the literature before 1925. In spite of the prevalence of cholecystic disease gall-stone ileus is remarkably infrequent. It should be noted that the cause of obstruction is usually not suspected before operation and a history of

chronic cholecystitis is of no value. The obstruction may be caused by the stone itself being too large to pass onward by producing an intussusception of the bowel, or by becoming embedded in the wall of the gut and secondarily closing the lumen. Usually the gall stone gets into the intestinal tract through a cholecystenteric fistula, and then travels onward to rest in the terminal portion of the ileum in the majority of cases. The fistula may not remain patent. Only 2 of the 136 cases of acute intestinal obstruction in this series were the result of gall stones.

Likewise, a few cases of mesenteric thrombosis will be found in most large series of acute intestinal obstruction. Although the large infarcts of the intestinal tract offer a hopeless prognosis, small infarcted regions, if recognized early can be handled surgically. The making of a distinction between arterial occlusion and venous thrombosis will help in diagnosis and prognosis, although simultaneous involvement of both types of vessels may also occur. Jackson and others have been able to collect 214 cases and have reported that 61 per cent were arterial and 39 per cent venous in nature. Sixty-four per cent occurred in males and the remainder in females. Larson found that the occlusion was arterial in 39 per cent venous in 44 per cent and both arterial and venous in 17 per cent. The changes in the bowel wall depend on the size of the vessel occluded the rapidity of occlusion and the adequacy of the colateral circulation.

When an acute occlusion of the mesenteric artery has occurred sudden colicky pain, vomiting, blood in the stools and vomitus, early abdominal distention, a tender abdomen, and an increase in number of leucocytes in the circulating blood are present. The condition is rapidly fatal and early operation is imperative.

Much more amenable to operation in the earlier phases are the patients who have mesenteric venous thrombosis in which progress of the disease is relatively slow. Pain of a colicky nature is present but abdominal rigidity is minimal in proportion to the abdominal tenderness. The number of leucocytes per cubic millimeter of blood is relatively low during the initial period of the disease but it

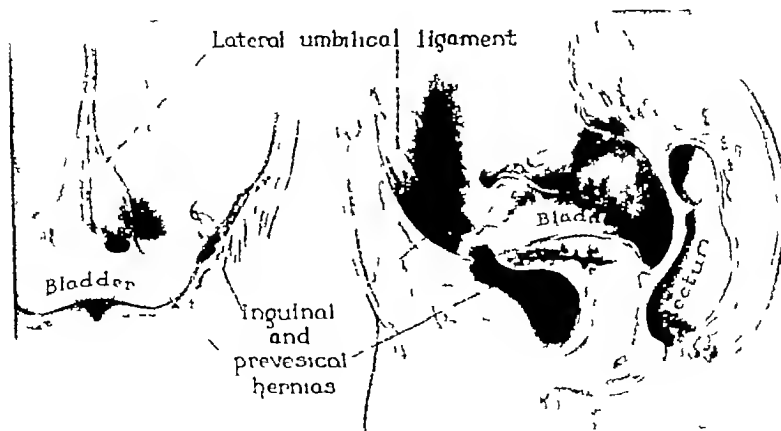


Fig 1 A prevesical hernia

rises rapidly later. Occult blood is uniformly present in the stool and occasionally, blood may be noted in the vomitus. An edematous discolored intestine is found at operation, but the muscular structure remains viable and peristalsis can be produced. If only a small region is involved, the collateral circulation may be sufficient to prevent further damage. However, all such sites should be removed to avoid (1) the danger of a possible subsequent perforation, (2) stenosis of the wall necessitating perhaps another operation later, and (3) formation of adhesions and later obstruction.

Massive involvement of the intestine was present in 2 of our cases, and the abdomen was closed as an exploratory procedure. Resection of about 15 inches (37.5 cm) of jejunum and a side-to-side anastomosis was necessary for the other patient. This case was recorded previously by Clagett and Gray.

Symptoms usually of purely mechanical obstruction are caused by mesenteric cysts. In 1934, Hugh-Jones analyzed 55 cases and found that 85 per cent of the cysts involved either the cecum or the ileum. An excellent summary of the material relative to enterogenous cysts has been made by Dockerty, Kennedy, and Waugh. Cysts in the terminal portion of the ileum are usually found during the first year of life as is illustrated by the case they reported. Mesenteric cysts are discovered in an older age group because obstruction occurs at a later date. Illustrative of this latter group is a 9 year old patient in

whom obstructive symptoms were caused by cysts which necessitated resection of a portion of the jejunum with end-to-end anastomosis, with excellent results in both.

Carcinoma of the bowel, particularly of the sigmoid and diverticulitis of the same region are relatively infrequently encountered causing acute intestinal obstruction. A study of the majority of such cases indicates that the obstruction is rarely acute, if the strict definition of the latter is used. The clinical cause may be comparatively prolonged before complete mechanical interruption of intestinal continuity is effected. The history, physical signs, and laboratory findings are somewhat characteristic and do not need special elucidation at this point. Occasionally, patients with short histories and signs of acute obstruction are encountered, and it seemed that there might be included in this series 5 patients with carcinoma and 2 with diverticulitis, who suffered acute interruption of intestinal humoral continuity.

The recognition that acute intestinal obstruction is present is far easier many times than is the discovery of the etiological agent or the choice of a therapeutic procedure. A careful history, a thorough physical examination, and meticulous, repeated observation of the patient, are essential. Some help will be obtained from the age of the patient, for as has been previously stated, certain types of pathological lesions are associated with various age groups. Thorough palpation of the

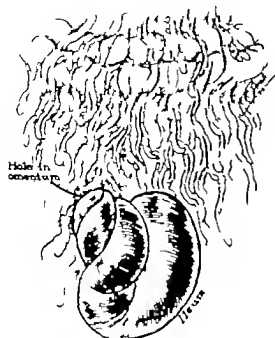


Fig. 1 An internal hernia the result of rent in the omentum

external orifices at which hernia may be present will disclose the cause in the majority of cases, whereas a history of a previous abdominal operation will suggest the possibility of another group.

The type, severity and site of pain and the localization of borborygmi are further factors that merit detailed consideration. Abdominal distention may or may not be present. Blood may be found in the vomitus or the stool so that conditions commonly associated with these particular findings should be considered first. Simple roentgenograms of the abdominal cavity, repeated if necessary, are valuable aids in localization. Gas is rarely seen in the small bowel in adults unless there is interruption of the intestinal continuity proximal to a patent ileocecal sphincter. Visualization of coils of the small intestine should indicate obstruction in these cases. If a distended horse-shoe colon is seen stasis in that particular part of the bowel has occurred. Above all else the presence or absence of a strangulating lesion must be primarily demonstrated as the mortality

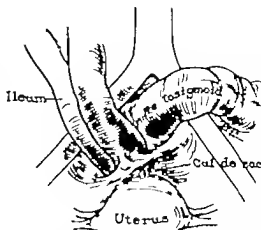


Fig. 2 A loop of terminal ileum adherent to caecum

rate rises sharply if patients who have a necrotic bowel are improperly treated. A rapid onset of symptoms with severe pain, vomiting and shock associated with peritoneal irritation, marked abdominal tenderness, splinting and increase in the number of leucocytes in the blood must suggest a strangulation of the bowel. The ratio of duration of the obstructive process to the mortality rate is a simple one: the longer the obstructive process lasts the greater the mortality.

Having made a careful analysis of the picture presented by the individual patient, the surgeon must plan his treatment accordingly. Simple mechanical obstructions of the small intestine early in the postoperative period, in cases in which the possibility of strangulating lesions can be eliminated, respond well to decompression of the bowel by use of the Wangenstein method. Such a statement is not universally true for obstructions of the small intestine caused by bands and adhesions in the late postoperative period. An analysis of the results in that particular group reveals a high incidence of strangulation. Signs indicative of this condition must be watched for and if not present conservative treatment may be employed. Colonic obstruction must be considered a strict contra-indication to the use of suction drainage. It is true that in some cases with a patent ileocecal fold decompression may be effective but the experience of seeing a few ruptured

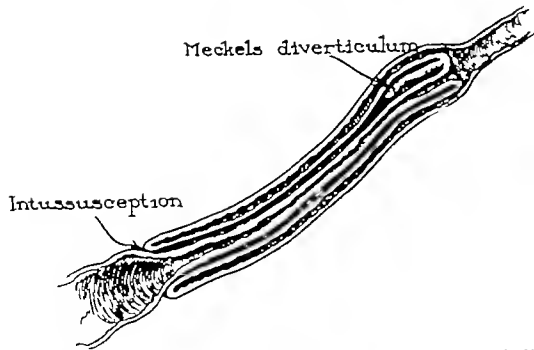


Fig 4 An intussusception originating with a Meckel's diverticulum

cecum will quickly influence the mind of the surgeon. Cecostomy or colostomy is the procedure of choice and does not carry an elevated risk in comparison with "blind" intubation.

Orr has estimated that approximately 7,300 to 8,000 cubic centimeters of fluid are secreted into the upper portion of the intestinal tract daily. Repeated vomiting in obstructive cases will lead to dehydration, depletion of blood chlorides, and alkalosis. Sufficient fluid must be given parenterally to insure an output of 800 to 1000 cubic centimeters of urine daily. Frequent estimations of the blood chlorides, carbon-dioxide combining power, and urea are necessities in the rational treatment of such patients.

When operation is indicated, the most conservative procedure possible under the existing circumstances should be employed, after the patient has been prepared for the operation. The preparatory period must vary with the individual patient and may at times be quite short. Favorable signs attendant on the release of the obstructing agent in strangulated loops are a return of the normal color to the bowel, pulsations in the vessels, and peristalsis on stimulation. Warm packs are placed around the liberated loop and 100 per cent oxygen is administered to the patient. A comparatively rapid accurate estimation of viability of the bowel can thus be made. When resection is necessary, the loop should be exteriorized and the continuity of the bowel restored later when the patient is in better condition. Primary resection, with closure of the bowel and side-to-side anastomosis is too

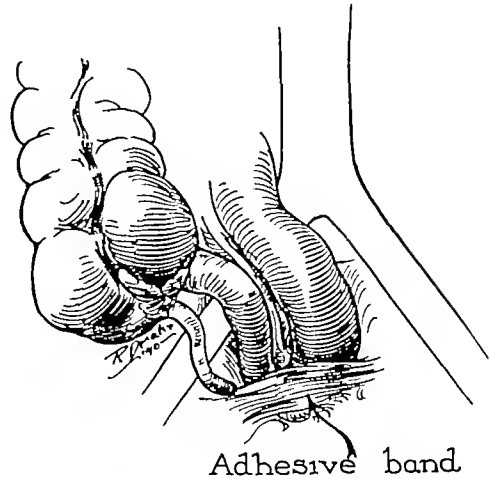


Fig 5 Acute intestinal obstruction from a strangulating band

hazardous a procedure unless a small lesion high in the intestine is present.

Useful postoperative adjuncts in therapy are blood transfusions and the use of 100 per cent oxygen employing the B L B inhalation apparatus (1). Loss of blood into the lumen in the case of strangulating lesions of the bowel may be considerable. Anoxemia of the patient and particularly of the bowel will be combated effectively by the use of oxygen.

Any consideration of treatment should include prophylactic measures designed to reduce the incidence of acute intestinal obstruction. Review of the cases in this series has demonstrated two important facts. External hernias account for a large majority of the cases and many of these patients are in the older age groups. Acceptance of old age as an excuse for employing prophylactic surgery for dangerous diseases is now gradually being withdrawn. As Clagett and Waugh have reported, an approximate mortality rate of 0.33 per cent was attendant on a series of almost 600 uncomplicated inguinal hernias repaired at the clinic during 1937 and 1938. The repair of a strangulated hernia carries with it many times such a risk. One should unhesitatingly recommend repair of all hernias at any time to forestall strangulation provided the patient is in a sufficiently good state of health.

The mortality from acute intestinal obstruction is high and will remain so until



Fig 6. Operative findings in volvulus of the small intestine.

educational measures can correct the situation. A correlation between the duration of obstruction or strangulation and the mortality rate is definite. This fact is strikingly confirmed in the present series in which the combined mortality in 136 patients was 22 per cent. Investigation of the patients who succumbed revealed that about half of them had been ill for more than 48 hours before coming to operation and an additional 3 had been ill about 48 hours. If it had been possible to have had most of these patients in the hospital earlier the mortality rate might have been reduced substantially. The following report of cases is appended to illustrate the difficulties which may be encountered in the diagnosis and treatment of acute intestinal obstruction.

#### REPORT OF CASES

**CASE 1.** A white woman 7 years of age had had extensive pelvic surgery about 7 months previously as a result of which she had been unable to eat for 2 weeks prior to admission when she began having moderate epigastric distress, mainly after meals. Five days before her admission, a severe colicky pain developed just below the

umbilical process; this pain projected toward the back between the scapulae. Frequent vomiting but no evidence of icterus was present. Normal appearing bowel movements had taken place twice. Roentgenograms made elsewhere had disclosed "stones at the mouth of the cystic duct."

On admission, the abdomen was slightly distended. Rigidity was lacking, but mild diffuse tenderness was noted. Leucocytes numbered 1,000 per cubic millimeter; 8 per cent were polymorphonuclear leucocytes. A roentgenogram of the abdomen revealed gaseous distention of the small bowel, especially of the jejunum. A diagnosis of cholecystic disease with calculus was entertained but intestinal obstruction could not be excluded and conservative measures were instituted. No great change in the condition of the patient resulted and exploration for the presence of obstruction of the small intestine was undertaken.

On opening the peritoneal cavity considerable serosanguineous fluid was present and the entire small intestine was dilated 4 or 5 times normal size. A loop of ileum, about 6 inches (15 cm) long, quite close to the ileocecal valve had become twisted on itself and had been occluded by a strangulating adhesive band (Fig. 5). Perforation of the proximal lumb of the occluded loop occurred while the structure was being gently freed. Resection of the loop would have necessitated sacrificing part of the right colon. Therefore, the necrotic portion was trimmed and the opening in the ileum was enlarged longitudinally. The rent was closed trans anally and an enterostomy was performed at a point 8 to 10 inches (20.3 to 25.4 cm) proximal to the region. A blood transfusion of 750 cc. was given, and an oxygen tent contributed greatly to smooth convalescence.

**CASE 2.** The following case has been reported elsewhere by one of us (Stalker). A bit man aged 4 years, registered at the clinic and complained of abdominal pain, nausea, and vomiting. Treatment had been administered elsewhere for 4 days and on registration here constant ache was present in the region of the umbilicus with tenderness in the right lower abdominal quadrant. Frequent vomiting of large quantities of bile-colored fluid occurred. Defecation had not occurred since the onset of pain, but daily high enemas were expelled with gas.

The patient was critically ill, extremely dehydrated and in a very poor condition. The abdomen was distended moderately, was tense and felt doughy. Generalized tenderness, most severe at the right and below the umbilicus, was present. A few distended loops of intestine could be palpated; marked abdominal succussion sounds were noted, and some audible peristalsis was present. It was obvious that the patient was ill for a medical surgical procedure. A blood transfusion, the intravenous administration of several liters of saline solution and continuous duodenal suction were instituted. Improvement in the general condition

was noted, but the abdominal findings remained about the same. A leucopenia was present, the number of leucocytes being 3,300 per cubic millimeter. Gaseous distention of several loops of small intestine was revealed by roentgenological examination.

Although the patient was critically ill, it was felt that maximal benefit had been obtained by this preoperative preparation, and consequently surgical intervention was advised. Approximately 2 liters of amber colored serous fluid were released when the peritoneal cavity was opened. The mesentery of the small intestine was found twisted on itself about three and a half times in a counterclockwise direction, 95 per cent of the small intestine was involved (Fig 6). Marked discoloration and distention of the affected small bowel was present. Untwisting of the mesentery resulted immediately in a return of normal color to the intestine and passage of some gas distally. No definite cause for the volvulus was found.

After operation, blood transfusion, Wangensteen suction, and concentrated oxygen therapy contributed materially to a smooth convalescence. The patient was dismissed from the hospital on the fourteenth day.

**CASE 3.** A white woman, aged 55 years, stated on registration that for 3 days she had suffered from generalized cramp like abdominal pains. Vomiting of bile colored fluid was frequent and she had not had a bowel movement or passed flatus for 2 days. Dyspepsia, the result of gall bladder disease, had been present for many years and 6 years before admission patient had suffered from acute cholecystitis.

Physical findings were limited to the abdomen. Tenderness and rigidity were not present and visible peristalsis was not observed. Borborygmi were heard during the attacks of crampy pain.

The leucocytes numbered 24,800 per cubic millimeter, 90 per cent were polymorphonuclear leucocytes. The constituents of the blood in milligrams per 100 cubic centimeters were urea, 80, chlorides, 462, and the carbon-dioxide combining power, 49.5. A simple roentgenogram of the abdomen revealed a short length of bowel in the upper portion of the abdomen filled with gas.

At operation, the upper part of the jejunum was found dilated to about two or three times its normal size and a gall stone was causing obstruction about 48 inches (120 cm) distal to the ligament of Treitz (Fig 7). The duodenum and gall bladder were freed and a cholecystoduodenal fistula visualized. A gall stone measuring 4 by 2 inches (10 by 5 cm) was removed from the jejunum and the opening in the duodenum was closed as a pyloroplasty. Cholecystostomy completed the operation. Her postoperative convalescence was smooth and was aided by the usual procedures.

The mortality resulting from acute interruption of intestinal humoral continuity is excessive as is evidenced by this and other reports. Chief among the causes of the death

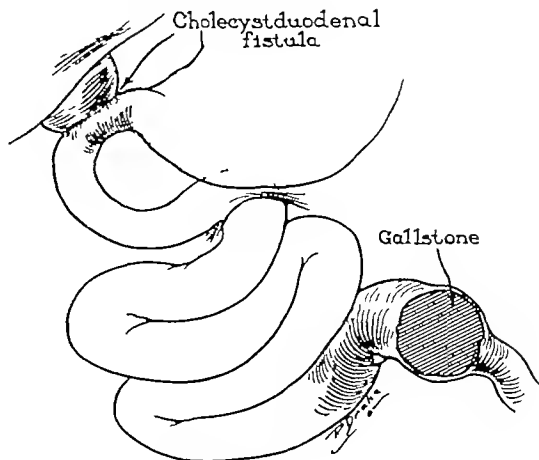


Fig 7 Acute ileus caused by gall stone in the jejunum

rate is the marked delay in recognizing and treating strangulating lesions. This fact is especially true in regard to the treatment of obstructions caused by bands and adhesions in the late postoperative period. Recognition and employment of the dictates advocated by Wangensteen and others should materially aid in the reduction of the excessive mortality rate. The prophylactic repair of hernias in suitable cases will reduce not only the incidence of obstruction but also the resultant mortality rate. The use of 100 per cent oxygen will be found valuable not only at the time of operation in making a decision in regard to the viability of bowel, but it also will prove helpful in the postoperative care of such patients.

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## REACTION OF BONE TO MULTIPLE METALLIC IMPLANTS

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RECENT papers by Venable and by Venable and Stuck have created new interest in the problem of finding metallic prosthetic material for bone repair. They have found that vitallium, an alloy of chromium, cobalt and molybdenum, is tolerated better than other metals or alloys and have ascribed this to its resistance to corrosion by body fluids. They have shown also that this resistance to corrosion is manifested by its non-reactance to electrolytic influences. Zeinert observed differences in electrical potentials between dissimilar metals and concluded that only a single metal should be used and that all metal should be removed as soon as possible. Hawley and Padula expressed the belief based on clinical experience that there was little choice between stainless steel and vitallium. Crowell has reviewed the status of metallic devices used in bone fixation particularly those made of vitallium and stainless steel. He emphasized the importance of resistance to corrosion and physical strength of such devices, but the question of the part played by electrolysis was not settled.

In 1924, Zierold made an intensive study of the reaction of bone to a number of pure metals and of alloys. He used 63 dogs and placed metallic implants in ribs, tibiae, and

femora. Gold, aluminum, and stellite (an alloy consisting mainly of cobalt, chromium and tungsten) were well tolerated and became encapsulated without hindering reparative processes. Silver and lead were almost as good but evoked a slightly greater connective tissue response.

Verbrugge has reported the results obtained from the use of magnesium and Dow metal (92 per cent magnesium, about 8 per cent aluminum and a small amount of manganese) both clinically and in experimental studies in dog and rabbit. These materials were absorbed but caused considerable reaction, and it was concluded that small nails of such materials could be used but not plates. McBride used with success in 20 human cases a similar alloy which contained 93.7 per cent magnesium.

Our work differs from that of Zierold in that multiple metallic implants are used in the same bone with the idea that electrolytic action might be exaggerated if the part it plays be of major importance. We have included two metals, titanium and manganese which we believe have not been studied previously.

*Experimental.* Holes about 1.5 millimeter in diameter were drilled in the shaft of the femur of cats with a dental drill and pegs of the metals to be tested fitted tightly into them. Aseptic precautions were used and the wounds



Figs 1 2 and 3 Roentgenographic positive prints of femurs of cats into which implants of various metals were made. The legend below the figures gives the figure number, which corresponds to the cat number in Table II, the survival time in days and the metals used. Read from top to bottom in identifying the metals in the bones. Each pair represents the same bone, photographed to give side and end views of the implants.



TABLE I.—ELECTRICAL POTENTIALS OBTAINED FROM METALS IN CAT FEMURS WITH COPPER, EITHER IN THE BONE OR ADJACENT MUSCLE USED AS A ZERO POINT OF REFERENCE. HYDROGEN IS PLACED WHERE IT WOULD OCCUR IN THE ELECTROMOTIVE FORCE SERIES

Metal	Potential volts
Cadmium and manganese	+0.90
Aluminum	.45
Ti	.30
Lead	.5
(Hydrogen)	
Titanium	.05
Copper, vitallium, and stainless steel	.00
Platinum (in muscle)	-0.30

were closed in layers with sutures of fine silk. A survival period which varied from 203 and 259 days, was allowed in 12 of the 15 cats used. Three died 8, 17 and 31 days, respectively after operation from respiratory infection. Readings of the voltage between the different metals were taken with a potentiometer in 4 of the animals, each of which had 4 implants in each femur. The readings were taken at the end of the experimental period on the anesthetized animal.

The following metals were used and the number after each indicates how many implants were made: aluminum 3, cadmium, 4, copper 5, iron (as soft steel) 4, magnesium 3, manganese, 6, lead 8, tin 4, titanium 3, zinc, 4, stainless steel, 4, and vitallium, 3. Four different metals were usually implanted in one femur.

**Results.** Electrical potentials varied from zero to over 0.40 volts (the limit of the potentiometer used). Such potentials obtained from a pair of different metals with living tissue as the electrolyte tended to be unstable but duplicate readings agreed sufficiently well to permit the computation of the data in Table I. Copper vitallium and stainless steel have been given the zero position arbitrarily. This was done because a copper electrode in the muscle was used to check against other metals in the bone. Copper in muscle to copper in bone gave readings from 0 to 0.02 volts. The potentials follow the same order as that of the electromotive force series of elements

with the exception of aluminum, which should have been positive to cadmium. In view of its reaction with the bone (contrary to Zierold's findings) the aluminum sample may have been impure.

Röntgenograms were made of the cleaned bones and are illustrated in Figures 1 to 15. Table II gives a condensed protocol of the observations on the bones correlated with the roentgenographic shadows.

#### EVALUATION

Electrical potentials are not an infallible guide concerning the amount of reaction between bone and metal. This should not be interpreted to disagree with the work of Venable and co-workers since they are dealing with current rather than potential. It does suggest however that electrolysis is an accompaniment of unfavorable bone reaction rather than the direct cause of it. Under our experimental conditions where electrolytic action should have been favored by adjacent dissimilar metals, each metal retained characteristic individuality of reaction. In interaction between bone and metal chemical reactivity is usually correlated with large positive potentials of the metal with relation to hydrogen in the electromotive series. Examples are manganese, magnesium, and aluminum. Cadmium however seems to be an exception in the strongly positive group since two of three implants showed little reaction to this metal. Metals negative to hydrogen might be expected to be non reactive but copper gives an unfavorable reaction which is due to the toxicity of its dissolution products. The individuality of a given metal may be illustrated by other examples. Manganese reacted as vigorously when implanted alone (Cat 14) as it did in company with other metals. The inert alloys and titanium remained inert in the presence of reactive metals (Cats 3, 8, 10, 11 and 12).

The response of bone to titanium was a good if not better than that to the non corrosive alloys, in that there was more tendency for the bone to fuse with it. It possesses the advantage of being an element and hence free from the theoretical objections to alloys, which were discussed in Crowell's report. If

From chromium, nickel, manganese alloy which contains small amounts of silicon, sulphur, phosphorus, and carbon.

TABLE II —REACTIONS OF FEMURS OF CATS TO MULTIPLE IMPLANTS OF VARIOUS METALS

Cat No and sex	Survival days	Metals used	Reaction
1 M	225	Stainless steel	No reaction
2 M	232	Zn,Sn,Pb Cd	A cystic cavity (0.5 by 1 by 2 cm) covered the 4 pins
3 M	218	Zn St S Pb Fe	Slight erosion about Zn others are tight in the bone
4 M	228	Pb Fe Sn,Zn	Some cortical thickening about all except Fe. It shows slight thinning. Sn and Zn show a trace of erosion between metal and bone
5 F	17	Zn,Sn,Pb Cd	Subcortical shadows about Zn and Pb. Time was too short for much bone reaction.
6 M	214	Mg only	Absorbed bone is smooth
7 F	266	Sn Pb Cd Al	Erosion immediately about Al with increased density around the eroded zone. Other metals show little effects
8 F	259	Al Cu Pb,St S	Both Al and Cu are similar to 7 Pb and stainless steel are practically negative
9 M	8	Cu Fe Pb St S	Time was too short for reaction
10 F	224	Mg Mn Ti Vit	Mg nearly absorbed erosion about Mn with small crater. Ti and Vit negative
11 F	224	Mg Mn Ti Vit	A fragment of Mg remains. The Mn was loose dropped out and there is crater and new bone formation around the site. Ti is partly covered by new bone which has extended also around the vitallium
12 F	31	Cu Mn Ti Vit	The Cu pin came out of the bone soon after operation and was found embedded in connective tissue. Mn is loose and there is crater formation and much callus around it. Ti and vitallium are negative
13 F	224	Al Cd Cu Fe	Probably infected. Al and Cd have sloughed into a cystic cavity. Cu and Fe are loose. Bone cortex and medulla are very dense
14 F	210	Mn Mn hole	One implant has been partly covered by callus the other remained loose in a crater and dropped out. There is increased density around the eroded area. The hole has healed
15 F	93	Hole Cu Mn Ph	The hole has healed. There is much callus heaped up around the Mn and increased density around it and the Cu. The callus has grown into contact with the Pb but avoided the Cu

TABLE III —ORBITAL ELECTRONS OF ELEMENTS WHICH CAN NORMALLY OR ABNORMALLY PARTICIPATE IN BONE METABOLISM

Element	Shell Orbit	K 1s	L 2s 2p	M 3s 3p 3d	N 4s 4p 4d 4f	O 5s 5p 5d 5f	P 6s 6p 6d	Q 7s
Be		2	2					
Mg		2	2 6	2				
Ca		2	2 6	2 6 —	2			
Ti (P)		2	2 6	2 6 2	2			
Mn		2	2 6	2 6 5	2			
Fe		2	2 6	2 6 6	2			
Sr		2	2 6	2 6 10	2 6 —	2		
Pb		2	2 6	2 6 10	2 6 10 14	2 6 10	2 2	
Ra		2	2 6	2 6 10	2 6 10 14	2 6 10	2 6 —	2

Data taken from the *Handbook of Chemistry and Physics* Chemical Rubber Publishing Company 1939

Lead, although positive to hydrogen, was well tolerated and this fact is probably correlated with the well known tendency for lead salts which have been absorbed in the body to be deposited in the bones. The close relationship between bone metabolism and certain metallic salts has been cited by Blumberg, Shelling, and Jackson, in a study of manganese rickets in rats. Salts of strontium, beryllium, magnesium, thallium, iron, aluminum, and lead are included in their list and specific references to experiments given. In our series, manganese gave a very marked reaction by causing a proliferation of new bone on the surface of the cortex for several millimeters around the implant, but resorption in the immediate vicinity of the metal.

There seems to be a correlation between the chemical properties of a metal (or its salt) to its reaction with bone. This phenomenon can be illustrated further by Table III wherein it is seen that there is much similarity in the configuration of electrons in the outer shells of the elements involved. The most closely related of the metals are magnesium, calcium, strontium, and radium. Each of these has 2 outer electrons in an s-orbit preceded by 6 in a p-orbit. Others not quite so closely related are beryllium, titanium, manganese, and iron, which also have 2 outer electrons in an s-orbit but are not preceded directly by a p-orbit. Lead, however, is aberrant by having two outer electrons in a p-orbit.

metallurgical developments of the future make it possible to work it into suitable shapes, it has the strength and hardness necessary for proper support. More experimental work is needed to prove it equal or superior to the noncorrosive alloys as a prosthetic material.

These relationships between metallic salts and bone metabolism, and similarities of atomic structure existing among such metals suggest that any relationship between metal and living bone is likely to be more firmly grounded on a chemical than on an electrolytic basis. Electrolysis, as manifested by an actual flow of current, should serve as a valuable guide regarding the solubility of a metal.

#### SUMMARY AND CONCLUSIONS

1. Implants of dissimilar metals into the same bone (cat femur) still showed differences in electrical potential after 7 months.

2. Such potentials were not closely correlated with bone reaction except in the case of the more soluble metals which were strongly positive in the electromotive series.

3. Two pure metals, manganese and titanium were included in the study and we believe that their reactions in bone has not been observed previously. Manganese was highly reactive and promoted much callus formation. Titanium was fully as well tolerated as vitallium and stainless steel, perhaps better in that the bone had a tendency to grow into contact with it.

4. Some theoretical reasons are given for believing that the response of bone to metal is based on chemical rather than electrical phenomena.

NOTE—The vitallium used, as furnished gratuitously by the Austenal Laboratories, and the stainless steel by V. Mueller & Co.

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# THE IVY BLEEDING TIME, SERUM VOLUME INDEX AND PROTHROMBIN CONTENT OF BLOOD IN ESTIMATING BLEEDING TENDENCY IN JAUNDICE

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IT is now well recognized that prothrombin deficiency is an important cause of hemorrhage. It has been adequately demonstrated that this deficiency may occur in the newborn due to a lack of vitamin K (3, 8, 10). In patients with biliary obstruction or fistula, bleeding is known to occur because of a deficient absorption of vitamin K, due in large measure to the absence of bile salts in the intestine. In other conditions where deficient intestinal absorption is a factor, a prothrombin deficiency may appear. Clark, Dixon, Butt and Snell have demonstrated it in intestinal obstruction, gastrocolic and other intestinal fistulas, ulcerative colitis, multiple polyposis, sprue, and in postoperative gastric retention. Bleeding occurred in some of these conditions. Finally, a deficiency of prothrombin has been shown to occur in various types of hepatic dysfunction (8, 9) due to an inability of the liver to form prothrombin.

These relatively recent additions to our knowledge concerning prothrombin deficiency have awakened a new interest in and made thorough the study of patients who might bleed after operation. Especially in the pre-operative and postoperative management of patients with jaundice or biliary fistula has it become imperative to know the status of the bleeding tendency. On it depends the time chosen for operation, the necessity for transfusion, or the success or failure of vitamin K and bile salt therapy.

In estimating the tendency to bleed, the most valuable information is the prothrombin time or the prothrombin percentage, which is usually obtained by the method of Quick (7). This method provides a direct means of measuring the rate of coagulation in oxalated plasma by a system wherein there is an excess of

thromboplastin and an approximately optimal content of calcium. The rate of coagulation is dependent, therefore, upon the prothrombin content of the plasma. The determination of prothrombin deficiency by this method is not difficult in large or well equipped laboratories by those who are skilled in laboratory methods. However, several reagents and a considerable equipment are necessary for the test, the most difficult to obtain is the thromboplastin solution. This requires maceration of rabbit's brain and several extractions with acetone. The resultant granular powder is unstable, it must be preserved in a refrigerator and even then it is found to retain its full activity for only a week. Quick advises that its activity should be checked against a normal plasma in estimations of prothrombin content of a questionable blood.

We decided to determine the value of two more simple clinical tests for determining the bleeding tendency in several patients with jaundice or biliary fistula. These tests were made on the same blood and at the same time that the prothrombin estimations were made, so that the results were comparable in every respect. We hoped the results obtained might be helpful to those in smaller hospitals where prothrombin estimations are not made routinely, or even in larger hospitals where it is desirable to follow the bleeding tendency from day to day. Furthermore, the tests can be rapidly performed at the bedside, with a minimum of apparatus and without the necessity of any skilled or trained personnel. If the determination of the tendency to hemorrhage can be estimated fairly accurately by clinical tests, it would seem practical to substitute them for laboratory procedures in many instances.

The two tests run simultaneously with the prothrombin determinations in this study were the Ivy bleeding time (6) and the serum vol-

TABLE I — DETERMINATIONS

Prothrombin percentage	Ivy bleeding time—minutes	Serum volume index
13	5	5
6	5 5	4
16	30	
8	3 5	67
6	4 5	69
6	4 5	66
30	5	45
30	30	% 5
3	6 5	66
30	20	76
27	5	66

ume index of Boyce (1) Neither test makes a quantitative estimation of the prothrombin content of blood but their value lies in the fact that indirectly their results depend upon it.

The Ivy bleeding test consists in observing the duration of bleeding by blotting away the drops of blood from a small puncture wound in the skin of the forearm, while the venous return is temporarily obstructed below a sphygmomanometer cuff inflated to 40 millimeters of mercury. At the time Ivy proposed his test (1935) less was known about the relation of prothrombin deficiency to bleeding but he recognized that the duration of bleeding from a puncture wound was a factor not only of the clotting function of the blood, but also of the contraction and retraction of the injured capillaries. He proposed to eliminate this factor of capillary tonus by increasing the pressure in capillaries and arterioles using a blood pressure cuff to obstruct the venous return. The duration of bleeding would then be almost entirely an index of the clotting function of the blood i.e. an index of prothrombin content. By Ivy's standard a bleeding time of more than 240 seconds (4 minutes) was considered as showing a tendency to bleed.

The serum volume test of Boyce and McFetridge is performed by collecting an arbitrary amount of blood, usually 3 cubic centimeters in a graduated tube allowing it to stand at room temperature for 4 hours. The clot is then removed and studied for firmness and retractility. An observation is made of the amount of serum remaining in the tube. In normal individuals this serum volume was found to equal 50 per cent of the original blood volume. In patients who had a tendency to bleed, the serum volume was found to be much less than this. A serum volume index was proposed

and was obtained by dividing the amount of serum left in the tube after removal of the clot by one-half the original blood volume. This index was one in normal individuals.

In performing this test it is essential to have at hand a red blood count because if the volume of corpuscles is reduced the resulting serum volume will be increased (5). Unless a correction is made the serum volume index will appear higher than it really is. Subtracting the red blood count of the blood tested from 5,000,000 the normal blood count the resulting figure is divided by 5,000,000 to give the percentage deficiency of red cells. This figure is then multiplied by one half the volume of the blood drawn to give the volume to be subtracted from the serum volume as read. The serum volume index is then calculated as usual the corrected figure being used.

Indices below 1.0 are considered as progressively indicative of a hemorrhagic tendency. The highest serum volume index at which the authors found bleeding was 0.71 the lowest at which hemorrhage did not occur was 0.78. It would seem then that the lower limit of safety is between 0.7 and 0.8. Boyce and McFetridge state however that they are unwilling to operate when the index is below 0.8.

This test, like the Ivy bleeding test is apparently an indirect measurement of prothrombin deficiency because the clot in patients with a decreased prothrombin content of the blood is larger softer and more friable than the normal. Therefore, the volume of serum left after removal of such a clot is less than normal.

In following the course of one patient with a complete biliary fistula, simultaneous determinations of the Ivy bleeding time and the serum volume index were made along with the determination of blood prothrombin levels by the method of Quick. The results showed a rather close parallelism. The findings in this case have been reported in a previous publication (5).

Our interest in further observing the results of these three tests applied to other individuals has led to the present study. From the results of studies of 27 jaundiced patients, in whom jaundice was due to various causes, we believe that there is sufficient correlation to warrant confidence in the use of the two simpler tests as adjuncts to or substitutes for

prothrombin studies, or in places where laboratory facilities for prothrombin determination are not available

We have divided our cases into two groups. One consists of patients showing a clinical bleeding tendency or a blood prothrombin level of 30 per cent or less. The other is made up of those patients having no clinical tendency to bleed or a blood prothrombin level of more than 30 per cent. Thirty per cent was selected arbitrarily as a level at which danger of bleeding due to prothrombin lack was imminent.

Table I includes 9 determinations in which the prothrombin percentage was 30 or less. In each of these patients, either the Ivy bleeding time or the serum volume index or both indicated a definite bleeding tendency. Three cases are marked by asterisks. In 2 of these the prothrombin percentage was greater than 30. 33 and 50 per cent, in both, a definite hemorrhagic tendency was suggested by the Ivy bleeding test, the serum volume index, and by clinical evidence of bleeding. In the third case, the serum volume index was 0.76, a figure not definitely indicating a bleeding tendency, though here the Ivy bleeding time was 10 minutes.

Table II includes those cases in which the prothrombin percentage was above 30. In none of these cases was there clinical evidence of bleeding. Seven patients showed a serum volume index between 0.7 and 0.8. Four cases are marked by asterisks. In 3 of these, the Ivy bleeding time indicated a bleeding tendency and, in the other, the serum volume index was reduced to a definitely critical level. However, in no case did both tests indicate a definite hemorrhagic tendency, although in 2 with the Ivy bleeding time prolonged the serum volume index was between 0.7 and 0.8.

In our series, therefore, either one or both of the two simple tests used in combination showed the tendency to hemorrhage in cases in which it was indicated by determination of the blood prothrombin level. In 2 cases both of them indicated the hemorrhagic tendency in agreement with the clinical evidence, while the prothrombin percentage did not. In 4 cases, however, 1 or the other of the simpler tests indicated a hemorrhagic tendency when there was no other evidence that it existed.

TABLE II —PROTHROMBIN PERCENTAGE

Prothrombin percentage	ABOVE 30	
	Ivy bleeding time—minutes	Serum volume index
65	3 5	72
*90	*4 5	*77
43	2 8	72
46	2 0	87
54	2 5	93
58	2 5	93
*90	*2 0	*52
100	2 5	74
35	2 5	73
100	2 5	94
100	2 0	1 0
70	2 0	94
*50	*6 0	*78
*40	*5 0	*88
48	2 5	1 0
43	2 5	78

## SUMMARY

We have compared three methods for determining the bleeding tendency in patients with jaundice or biliary fistula. The method of Quick for determining blood prothrombin percentage requires certain laboratory facilities and material as well as skilled personnel, not always easy to obtain. The two other tests, which are simple bedside procedures requiring no specially prepared reagents and no elaborate equipment, compared favorably with the Quick method.

We believe that their correlation with the blood prothrombin level is close enough and their indication of a tendency to bleed accurate enough to give them a definite value in the study of such patients, either as confirmatory procedures where prothrombin determinations are obtainable or alone where elaborate laboratory facilities do not exist.

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# PERFORATED PEPTIC ULCER

## A More Accurate Method of Roentgen Diagnosis

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THE purpose of this paper is to show the value of roentgen examination in the left lateral decubitus position in ascertaining the presence of air under the diaphragm. Since the earliest notations by the German writers, Popper and Weiland, concerning the "radiologic phenomenon" associated with perforated viscera, namely the finding of air beneath the diaphragm, numerous writers have concentrated their efforts in establishing the value of x ray examination in such cases. That they have succeeded is attested by the fact that in cases of questionable perforation roentgen examination is now used universally as a diagnostic procedure.

Reports of atypical cases of perforation in which the diagnosis was made only by x ray are numerous. Most writers have found however that approximately 20 to 25 per cent of cases of perforated viscera do not show air beneath the diaphragm when the examination is made with the patient in the upright position. Petren in a series of cases reported in 1937 did not find gas in 39 per cent. With careful examination sometimes aerial, in the left lateral decubitus position this percentage has been reduced to 11 per cent in a series of 68 cases seen at the San Francisco Hospital in the past 5 years.

Examination of the patient in the left lateral decubitus position is not a widely known or accepted procedure. The majority of examinations for demonstration of air under the diaphragm are still made with the patient in the upright position only.

The reasons for the universal reliance upon the upright position seem to be (1) The "weight of custom"—"the upright position has always been used therefore it must be the best projection." (2) Only a few series with examinations in both positions have

been reported. (3) Conflicting reports in the literature as to the relative values of the left lateral decubitus position.

As late as 1937 we find this statement "The one absolute essential [to the demonstration of pneumoperitoneum] is that the patient be put in the upright position during the x ray exposure." (7) Another article published in 1938 states "Roentgen examination in the left lateral decubitus position is useful when the patient cannot be placed upright. However if pneumoperitoneum is observed at all on the x ray film it will be seen between the right dome of the diaphragm and the liver in 60 per cent of the cases" (8).

These statements contrast with those of Vaughan and Singer who in 1933 in conclusion to a study of 97 cases of perforated ulcers, stated that "the optimum position [to demonstrate free peritoneal air] is with the patient lying on his left side. It is unnecessary to place the patient in a sitting or other position. Clarkson and Barker in a subsequent article corroborated this point. Finsterbusch and Gross in *Acta Radiologica* 1938 likewise stated that they "prefer the left lateral decubitus position because in that position very small amounts of gas can be seen more readily in contrast with the dense shadow of the liver the diaphragm, and the lateral wall of the abdomen."

Darbous and Sobel in 1930 after performing a number of experiments on cadavers by forcing air into the stomach and out through perforations in the duodenum, made the statement that air passed most freely into the peritoneal cavity when the cadaver was placed in the left lateral decubitus position.

### DEFINITION AND TECHNIQUE

By the term "left lateral decubitus position" is meant a posterior-anterior examination with the patient lying on his left side with his right

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side up (Fig 1) The x-ray is directed horizontally to the film placed on the opposite side of the patient The film is placed to include the liver area and lower right lung field

#### RATIONALE—ANATOMICAL AND PHYSIOLOGICAL CONSIDERATIONS

What is the rationale of the left lateral decubitus position? Our query first brings us to a consideration of the diaphragm and its relationship to the liver Quoting from Gray's *Anatomy* "Skiagraphy shows that the height of the diaphragm in the thorax varies considerably with the position of the body When the body is horizontal and the patient on his side, the two halves of the diaphragm do not behave alike The uppermost half sinks to a level lower even than when the patient sits, and moves little with respiration, the lower half rises higher in the thorax than it does when the patient is supine, and its respiratory excursions are much increased" Thus there is, in the left lateral decubitus position, a pump-like action, the lower left half of the diaphragm, by its vigorous movements, forces any free intraperitoneal air upward into the space between the relatively stationary right leaf of the diaphragm and the liver

The next structures with which we are concerned are the stomach and duodenum We are especially interested in the pyloric region, as the great majority of perforating ulcers occur here on the anterior surface As is well known, ulcers pointing posteriorly penetrate, but do not easily perforate because of the proximity of the tissues behind them

Roughly, the gross outline of the stomach can be considered to resemble the letter J (Fig 2a) The hook of the J, extending from the left to the right of the midline, is made up of the pyloric antrum and duodenal bulb It is readily seen that if the patient were in an upright position, even a relatively small amount of fluid would fill the hook of the J, the antrum and cap, and block any air from escaping from a hypothetical hole in this region (the site of rupture in 80 to 90 per cent of all cases) Also in this position fluid escapes more easily, increasing the possibility of peritonitis or subphrenic abscess On the other hand, if the patient were lying on his

left side, the contents of the stomach would gravitate to the cardia and fundus, and air could readily escape through the rent in the pylorus or duodenum (Fig 2b) Clarkson and Barker report in 1935 "In order to minimize as far as practicable the escape of fluid and solid matter, a patient suspected of having a perforated peptic ulcer should be kept constantly on his left side with the upper half of the body elevated" Vaughan and Singer elaborate on this point in cases of suspected small perforations They state "In a number of *forme fruste* perforations, where the clinical diagnosis was at first obscure, we have succeeded in establishing the presence of a ruptured air-containing viscus by a simple maneuver After the initial negative fluoroscopic examination, the patient is placed upon his left side and is ordered to remain in that position If the perforation is still patent, or, if previously sealed re-opens, air will escape into the abdominal cavity This air can be detected after an interval of one to several hours following the first observation"

One consideration of examination in the upright position is the possibility of confusing gas in the stomach or splenic flexure of the colon with free peritoneal air In a recent case this error was made—supposed air was seen in the upright position, but none in the left lateral decubitus position No ulcer was found at operation

In this series of 227 cases of perforated viscera at this hospital in the past 5 years, 19 cases, or 8 per cent, showed air under the diaphragm on the left side only, when erect Some difficulty was encountered in trying correctly to interpret these cases

#### ADVANTAGES OF THE LEFT LATERAL DECUBITUS POSITION

The advantages of the left lateral decubitus position are numerous, there are few possible disadvantages One important advantage has already been mentioned, namely, the avoidance of unnecessary risk of leakage and spread of gastric contents Other advantages may be listed under the headings (2) time conservation and consideration of patient, (3) interference of subphrenic adhesions eliminated, (4) ease and accessibility of examination,



(5) reduction of expense of examination (6) differentiation from subphrenic abscess and (7) greater contrast on wet films in left lateral decubitus position. The possible disadvantages would be (1) lungs not so well visualized (2) interposition of bowel and (3) overlying peritoneal fat line which might be mistaken for air.

*Time conservation and consideration of patient.* Time is an important element in these cases. There is no question as to the direct relationship between the mortality rate and the length of time elapsing after perforation before operation. However as has been mentioned it is often necessary for a period of time to elapse for a visible quantity of air (5 to 10 cubic centimeters) to accumulate beneath the diaphragm. One of the characteristics of a patient with a perforated ulcer is the fact that he will not move or allow himself to be moved. Eusterman and Balfour in their book *The Stomach and Duodenum* quote Moynihan who vividly describes the symptoms of a patient with a perforated ulcer "The agony suffered by the patient is almost beyond belief what strikes every onlooker is that the patient's body is rigid and motionless *no slightest movement dare be attempted*. How then can we stand or sit a patient up for several minutes who is in excruciating pain? This is unthinkable and not at all necessary when the left lateral decubitus position is used. It is now the practice at the San Francisco Mission Emergency Hospital to turn these patients on their left side immediately upon entrance. There is always some delay in history taking and physical examination. By the time the patient is brought to the x ray department some time has elapsed and a film may be taken at once.

Examination in the left lateral decubitus position is a much safer procedure than examination in the upright position. Patients who are in shock, as most of these patients are, are not placed in a position which is the reverse of the accepted treatment. Before this procedure was established, one patient who was in shock before being placed upright died 2½ hours following the examination. His death was attributed partially to the trauma of the examination.

*Adhesions.* Adhesions may seal the subphrenic space. Many cases of perforated ulcers have histories of repeated attacks. Payne and Rigler noted, on experimental injection of air into patients with abdominal lesions, that in some cases the place where air was first seen was lateral to the right lobe of the liver instead of above it. In one case despite the establishment of a large diagnostic pneumoperitoneum of 1,400 cubic centimeters of carbon dioxide no gas ever appeared under the right diaphragm and only a small portion under the left. This observation was interpreted as indicating extensive adhesions between the under surface of the diaphragm and the liver and spleen, and a subsequent laparotomy demonstrated the presence of an extensive tuberculous peritonitis. They made the conclusion "It is obvious that in cases of this type examination in the upright position as usually done would fail to reveal gas. Examination in the left lateral decubitus position is of very great value under such conditions, as gas can thus be demonstrated between the lateral abdominal wall and the liver even if the subphrenic space is sealed."

*Ease of examination.* Examination in the left lateral decubitus position is not only much easier and safer for the patient but is also a more simple technical procedure. One technician can handle the patient. No assistance is needed to hold the patient motionless in position. A portable machine may be used to take the film and indeed the examination may be done in the ward or in the admission room, either in the bed or on the gurney without even moving the patient.

*Expense.* The objection may be raised that an additional film is expensive and could not be used as a routine procedure. This can be answered by the fact that a smaller film may be used (8 by 10 or 10 by 12) than is generally used for the upright examination. In the great majority of cases, an upright film will not be necessary. Follow-up examinations can be done with a total cost that is less than that of the ordinary one upright examination.

*Differentiation from subphrenic abscess.* In the case of a subdiaphragmatic abscess, Buckstein states "While a subdiaphragmatic ab-

cess may be seen in the roentgen examination of the chest in the erect position, showing the elevation of the right diaphragm, the abdominal condition present is seen to best advantage in the roentgenogram of the abdomen in the lateral position." Payne and Rigler also add the statement that "information gained from a film made in the left lateral decubitus position, when taken with the upright, is often valuable in deciding whether an accumulation of gas seen under the diaphragm is free in the peritoneal cavity or localized in an abscess. We feel that a gaseous shadow which shifts with change in the patient's position is confirmatory evidence of this point."

*Contrast greater on wet films in left lateral decubitus position* In a case of perforated viscus, the wet film must be examined. Contrast, then, is very important. The black line of air is seen to best advantage when in contrast to the white shadow of the liver in the left lateral decubitus position (Fig 3). In the upright projection frequent irregu-

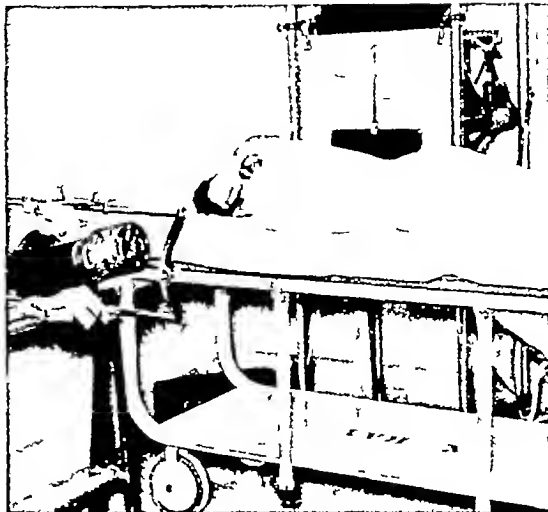


Fig 1 The left lateral decubitus position

larities in the central portion of the diaphragm and the overlying lower ribs also cause difficulty in interpretation. Often there is a low-grade pneumonitis and associated pleuritis which will obscure detail in the upright roentgenograph. In Case 1, this factor caused an erroneous diagnosis to be made (Fig 4 a and b).

#### POSSIBLE DISADVANTAGES

*Pathological changes in lung missed* An objection that has been raised to the routine



Fig 2 a and b, Position of the stomach in the upright and left lateral decubitus projections. The arrow in the left lateral decubitus projection points to a small collection of fluid barium in the base of the duodenal bulb with air above it. Note that the juxtapyloric area, the actual site



of rupture in 80 to 90 per cent of cases, is below the fluid level in the upright roentgenograph and above it in the left lateral decubitus position. Air from a perforation in this area could escape only if the stomach were in the latter position.

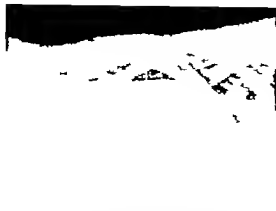


Fig. 1. Spontaneous pneumoperitoneum in the left lateral decubitus position. The greater contrast between the air collection and the liver enables the roentgenologist to visualize smaller collections with greater accuracy. This illustration shows that the base of the low or right lung can be well visualized. With the patient in this position, if there were any pathological pulmonary change, it could readily be demonstrated here.

procedure of taking only left lateral decubitus films is that pathological changes in the chest may be missed. In this series of 232 cases, only 17, or 7 per cent, showed evidence of pneumonitis of the right base. This was shown equally as well in the left lateral decubitus position as in the upright position.

Moreover, even if pneumonitis were present with the perforation, the treatment of such will be essentially unaltered. Eight of the 17 cases with pneumonitis died. The 4 that were autopsied showed death to be due to Generalized peritonitis following a ruptured ulcer and terminal bronchopneumonia.

*Interposition of intestine.* Another disadvantage that might possibly be listed is that there may be an occasional loop of bowel interposed between the liver and diaphragm. This change is so rare as to be of negligible importance. We have seen it in only 1 of our cases and were able to differentiate free air from it (Case 2).

*Properitoneal fat line.* A questionable third disadvantage is that occasionally the properitoneal fat line might be confused with air between the lateral thoracic wall and the diaphragm. However, this should not give rise to mistaken diagnosis by the experienced observer.

#### SAN FRANCISCO HOSPITAL STUDY

At the San Francisco Hospital, during the past 5 years, 237 cases of proved perforated viscera had x ray examinations in the upright position to ascertain the presence of pneumoperitoneum. Of these cases 173, or 76.2 per cent, showed air beneath the diaphragm, 54, or 23.8 per cent did not. Sixty-eight had x ray examinations in the left lateral decubitus position. Sixty-one, or 89.7 per cent of these cases revealed pneumoperitoneum, 7, or 10.3 per cent did not, a difference of approximately 13.5 per cent in favor of the left lateral decubitus position examination (Table I).

TABLE I.—COMPARISON OF TOTAL UPRIGHT AND TOTAL LEFT LATERAL DECUBITUS EXAMINATIONS

	Cases	Pneumoperitoneum	Percentage of positive diagnoses
Left lateral decubitus	68	6	89.7
Upright	237	73	70
Percentage difference			13.5

Another group of 63 cases of perforated viscera which had been proved by surgery or autopsy had examinations in both the upright and left lateral decubitus position. These 63 cases included 52 cases of perforated jejunal ulcers, 3 cases of perforated lesser curvature gastric ulcers, 1 case of marginal ulcer after gastro-enterostomy, 4 cases of traumatic perforations, 1 case of spontaneous perforation of the large intestine, 1 case of perforation of the lower esophagus and diaphragm (following esophagoscopy), 1 case of ruptured appendix. The term "justapyloric" is used because often the operating and autopsy surgeons cannot agree as to which side of the pylorus the perforation occurs. In this series of 63 cases, in which both the upright and left lateral decubitus positions were used to attempt to demonstrate pneumoperitoneum, only 7 cases, or 11 per cent, did not show air in the left lateral decubitus position, 14 cases, or 22 per cent, did not show air in the upright position. This is a difference of 11 per cent (Table II).

The percentage of positive diagnoses of pneumoperitoneum in reported cases of perforated viscera in the literature is approximately 75 per cent. It was also approximately



Fig. 4. a and b, Roentgenographic examination of the same patient (Case 1) in an upright and left lateral decubitus position. Pneumonitis at the right base obscures

the pneumoperitoneum in the upright projection. Definite free subdiaphragmatic air can be visualized in the lateral roentgenogram.

this figure (76.2 per cent) that was obtained in this series when only the upright projection was used. According to this figure, we should expect that in our subsequent series of 63 cases, there would be 48 cases in which pneumoperitoneum would be demonstrated. Moreover, as pneumoperitoneum was demonstrated in 57 cases, we should expect that in 9 cases air could be seen only in the left lateral decubitus position. There were 8 cases in this series that did show air only in the left lateral decubitus position. In 1 case, and only 1, that of a stab wound in the right lower quadrant with perforation of the ileum, air was seen in the upright projection and not in the left lateral decubitus position.

In almost all our cases, when air could be seen in the upright film, it was much more clearly demonstrated in the left lateral decubitus position. A rough estimate of the area of air seen under the diaphragm in the upright position was compared with the quan-

tity seen in the lateral position. This estimate was made by multiplying the length of the air column by the height in each case. This gave a ratio of 3.2 favoring the left lateral decubitus position.

#### CASE REPORTS

**CASE 1.** J. T., (Fig. 4 a and b) 60-year-old white male who, 4 days before entry, was seized with a sudden attack of excruciating abdominal pain arising in the left lower quadrant and radiating to the right at the level of the umbilicus, and gradually increasing in severity. Upon consulting a physician, he was advised to take soda and a bottle of citrate of magnesia. This tended to increase the pain, which became generalized. He was sent to another hospital where two enemas were administered, without relief. After a consultation and laparotomy was decided upon, he was transferred to this hospital. Physical examination disclosed a board-like abdomen distended throughout with generalized tenderness. X-ray report: "No evidence of subdiaphragmatic air, probably low intestinal obstruction." At that time (5 years ago), in spite of the fact that the left lateral decubitus film showed subdiaphragmatic air, it was not considered to be of significance because no air was seen in the upright. Operation was performed to relieve obstruction. The lower abdomen was explored but no obstruction was found. A cecostomy was performed. Because of the failure to find a lesion in the lower abdomen, an upper right rectus incision was made. Yellowish fluid was encountered and, upon exploration, a perforation of the stomach was found 1 centimeter proximal to the pyloric ring.

**CASE 2.** J. H., a 52-year-old white male, entered with history of inability to swallow solid food and a

TABLE II—ANALYSIS OF SERIES IN WHICH BOTH UPRIGHT AND LEFT LATERAL DECUBITUS EXAMINATIONS WERE MADE

Total Cases—63

	Pneumoperitoneum			Air in only this projection		
	Posi- tive	Per cent	Nega- tive	Per cent	No cases	Per cent
Left lateral decubitus	56	88.9	7	11.1	8	12.7
Upright	49	77.7	14	22.3	1	1.5
Percentage differences					11.2	



Fig. 5 a and b, Comparison upright and left lateral decubitus examinations (Case 4). A surgical note at time of operation states, "An upright film of the abdomen fails to demonstrate air beneath the diaphragm. The left lateral decubitus projection showed air but evidently was

disregarded by the surgeon. The upright film (Fig. 5a) shows the difficulty of interpretation when there is question of air beneath the left leaf of the diaphragm only. Gas in the stomach and the splenic flexure of the colon may simulate or obscure pneumoperitoneum.

loss of 4 pounds in eight over period of month and half. Patient was esophagoscoped on entry and it was found impossible to pass the esophagoscope beyond constricting lesion, apparently at the cardiac opening of the stomach. A biopsy of this tissue was taken which, upon sectioning, was found to be fat. Posterior-anterior and lateral roentgenograms made upright revealed no air under the diaphragm in the chest or mediastinum. A left lateral decubitus film revealed air under the diaphragm. At operation no perforation was found. The patient expired 3 days later. A large anular carcinoma involving the cardiac orifice of the stomach and extending centimeters into the esophagus was found at au-

topsy. There was generalized peritonitis and rent in the diaphragm along the suture line. Careful dissection revealed small, ell shaped-off perforation on the posteromedial surface of the esophagus at the level of the esophageal hiatus of the diaphragm.

CASE 3 G. G. 33 year-old but male he had been in the hospital for week under observation for either supposed gastro-intestinal malignancy coronary artery disease. Approximately 7 hours before being seen in the x-ray department, he developed sharp epigastric pain which soon radiated over the entire abdomen and to the left shoulder. He vomited once. Physical examination revealed a board-like rigidity of the abdomen. X-ray examina-



Fig. 6 a and b, Roentgenogram of this patient (Case 5). He was so ill that she had to be examined at the bedside. A large amount of air is seen in the lateral projection.

In the upright film the findings are questionable. In the lateral projection, great air can be visualized to allow positive diagnosis.

tion revealed at first examination no air in either the upright or the left lateral decubitus position. After lying on his left side for 20 minutes, air was seen beneath the diaphragm in the left lateral decubitus position. Operation was performed and a perforated ulcer, 8 millimeters in diameter, was found on the anterior surface of the duodenal bulb.

CASE 4 O H (Fig 5 a and b), 51-year-old white male entered complaining of sudden onset of agonizing abdominal pain radiating to his right shoulder. The patient vomited three times after onset. There was a past history of epigastric pain, relieved by soda. Physical examination revealed board-like rigidity of the abdomen. A surgical note at the time of operation stated "An upright film of the abdomen fails to demonstrate air beneath the diaphragm." The left lateral decubitus projection showed air, but evidently was disregarded by the surgeon. At operation a 6 millimeter perforation, 1 centimeter proximal to the pylorus, was found on the anterior gastric surface.

CASE 5 D T (Fig 6 a and b), 45-year-old negro female, entered hospital complaining of anorexia, loss of weight, and tarry stools. On the day after admission she developed severe non-radiating abdominal pain. Physical examination revealed a board-like abdomen. Patient was so ill that only a portable x-ray examination was possible. The patient could not be placed in the total upright position, but, in a 45 degree upright projection. No air was seen under the diaphragm. However, in the left lateral decubitus position, a considerable amount of air was seen. Patient refused operation and died the next day. Autopsy revealed an 8 millimeter perforation on the lesser curvature of the stomach, 6 centimeters proximal to the pylorus. There was also a small posterior perforation which was, however, sealed by adhesions to the pancreas.

CASE 6 E V, 55-year-old white male, entered hospital complaining of severe abdominal pain of 20 hours' duration. Patient had history of longstanding "heart burn" and belching. Physical examination revealed râles at both bases. The abdomen showed board like rigidity. X-ray report "No gas can be definitely identified beneath either leaf of the diaphragm in the upright radiograph. A small bubble is present under the right leaf in the left lateral decubitus position, indicating a visceral perforation." Patient was treated conservatively by Wangensteen suction. He expired the following day. At autopsy a generalized peritonitis was found, the result of a perforated duodenal ulcer.

CASE 7 A E (Fig 7), 72-year-old white male, entered the hospital complaining of severe epigastric pain of 3 days' duration. Physical examination revealed generalized abdominal tenderness most marked in the right lower quadrant. There was no guarding. No masses were palpable. The upright examination was questionable as to the presence of air, but there was definite air shown in the left lateral decubitus position. Due to the poor condition of the patient, conservative treatment was



Fig 7 Pneumoperitoneum in a case of a ruptured appendix (Case 7). Air was seen to best advantage in the left lateral decubitus position. This examination may prove of value in cases in which there is a possibility of a perforated appendix.

decided upon. The patient expired the following day. Postmortem examination revealed a ruptured appendix with general peritonitis.

#### SUMMARY

1 The rationale of, and the advantages and possible disadvantages of the left lateral decubitus position are presented. The advantages in favor of this position far outweigh any possible disadvantages.

2 In a series of 227 cases of proved perforation, in which the upright film was taken, pneumoperitoneum was shown in 173 cases, or 76.2 per cent. In a series of 68 cases, in which the left lateral decubitus position was taken, pneumoperitoneum was demonstrated in 61 cases, or 89.7 per cent, a difference of 13.5 per cent in the two series.

3 Analysis of a series of 63 cases, in which both the upright and left lateral decubitus positions were used, showed pneumoperitoneum to be demonstrated in 77.7 per cent in the upright position and 88.9 per cent in the left lateral decubitus position. In 15 per cent it was shown only in the upright projection and not in the left lateral decubitus projection. In 12.7 per cent it was demonstrated only in the left lateral decubitus projection and not in the upright projection. Thus, at this hospital, about 13 per cent more positive diagnoses were possible by the use of the left lateral decubitus position.

4 One case of pneumoperitoneum following ruptured appendix is included in this series. This is the only proved case in this hospital in which this procedure has been done. Only a few such cases have been reported in the literature. It is possible that this position might prove to be a valuable aid in diagnosing obscure or questionable cases of ruptured appendix.

#### CONCLUSION

The left lateral decubitus position is the position of choice in the roentgen examination of all cases of possible perforated viscera. If no air is seen, the upright position may be used as a supplementary procedure. In our experience however this latter examination has been of only occasional assistance.

It should be remembered that not only is the left lateral decubitus position the position of choice for roentgen examination, but it also minimizes the escape of gastric contents into the peritoneal cavity during the time necessary before surgical procedure is instituted.

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# PREGNANCY AND EXPERIMENTAL PULMONARY TUBERCULOSIS IN RABBITS

HUGH E. BURKE, M D, Ray Brook, New York

**U**NCERTAINTY regarding the effect of pregnancy on tuberculosis is, as Krause (1935) has pointed out, mainly due to the following factors (1) failure of most investigators to include suitable controls, and (2) failure, on the part of far too many who treat the condition, to separate the effect of pregnancy from those of parturition and the puerperium. To these factors may be added one other, namely, a seemingly complete lack of precise experimental evidence regarding the relation of pregnancy to pulmonary tuberculosis.

Data concerning the effects of pregnancy and parturition on experimental pulmonary tuberculosis in rabbits are presented in this discussion.

## EXPERIMENTAL

The observations to be recorded herein were made during the course of a series of studies (1935, 1940) of the x-ray and necropsy findings in experimental pulmonary tuberculosis in rabbits. Two hundred and forty rabbits were used in the series of studies. The animals may, for the purpose of the present study, be divided into two groups, namely (1) those which were injected intratracheally with a measured quantity of human tubercle bacilli (H<sub>37</sub>) and in which the disease was essentially retrogressive, and (2) those which were injected intratracheally with graded doses of bovine tubercle bacilli (B<sub>1</sub>) and in which the disease was essentially progressive.

The published accounts (1935, 1940) of the foregoing studies include descriptions of the manner in which the rabbits were injected and of the procedures employed in tracing the evolution of the pulmonary lesions. They do not, however, contain mention of the fact that in spite of efforts which were made to keep the sexes apart, a few of the animals gave

birth to young on one or more occasions. The procedure adopted when a rabbit gave birth to young was to record the date that the litter was born and to destroy the young before they had a chance to suckle.

An analysis of the records of the 240 rabbits included in the series of studies mentioned showed that 21 rabbits gave birth to mature litters on one or more occasions. Nine of these 21 animals were in the group which was injected intratracheally with a measured dose of human tubercle bacilli, the 12 remaining, in the group which was injected with graded doses of bovine micro-organisms.

## RABBITS INJECTED INTRATRACHEALLY WITH HUMAN TUBERCLE BACILLI

These rabbits, 134 in number, may be divided into two groups, namely (1) those which were healthy prior to the intratracheal injection and in which primary tuberculosis developed, and (2) those which had been inoculated in the groin with an attenuated strain of tubercle bacilli (R<sub>1</sub>) and in which reinfection tuberculosis developed immediately following the intratracheal injection. All of the rabbits in both groups were injected intratracheally with a single dose (1 mgm) of human tubercle bacilli (H<sub>37</sub>). X-ray and necropsy examinations showed that the resulting lesions in the rabbits in both groups, though strikingly different in mode of development, were essentially retrogressive in nature. The lesions regularly progressed during the first, and part of the second, months following the intratracheal injection, and then, with a few exceptions, retrogressed leaving either no demonstrable lesion or only a small residual focus in the pulmonary parenchyma. Most of the rabbits were killed to permit of study of the lesions at different stages of the disease. Only 1 animal actually died of tuberculosis.

From the New York State Hospital for Incipient Pulmonary Tuberculosis, Ray Brook, New York.



4 One case of pneumoperitoneum following ruptured appendix is included in this series. This is the only proved case in this hospital in which this procedure has been done. Only a few such cases have been reported in the literature. It is possible that this position might prove to be a valuable aid in diagnosing obscure or questionable cases of ruptured appendix.

#### CONCLUSION

The left lateral decubitus position is the position of choice in the roentgen examination of all cases of possible perforated viscera. If no air is seen the upright position may be used as a supplementary procedure. In our experience however this latter examination has been of only occasional assistance.

It should be remembered that not only is the left lateral decubitus position the position of choice for roentgen examination, but it also minimizes the escape of gastric contents into the peritoneal cavity during the time necessary before surgical procedure is instituted.

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# PREGNANCY AND EXPERIMENTAL PULMONARY TUBERCULOSIS IN RABBITS

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Data concerning the effects of pregnancy and parturition on experimental pulmonary tuberculosis in rabbits are presented in this discussion.

## EXPERIMENTAL

The observations to be recorded herein were made during the course of a series of studies (1935, 1940) of the x-ray and necropsy findings in experimental pulmonary tuberculosis in rabbits. Two hundred and forty rabbits were used in the series of studies. The animals may, for the purpose of the present study, be divided into two groups, namely (1) those which were injected intratracheally with a measured quantity of human tubercle bacilli (H37) and in which the disease was essentially retrogressive, and (2) those which were injected intratracheally with graded doses of bovine tubercle bacilli (B<sub>1</sub>) and in which the disease was essentially progressive.

The published accounts (1935, 1940) of the foregoing studies include descriptions of the manner in which the rabbits were injected and of the procedures employed in tracing the evolution of the pulmonary lesions. They do not, however, contain mention of the fact that in spite of efforts which were made to keep the sexes apart, a few of the animals gave

birth to young on one or more occasions. The procedure adopted when a rabbit gave birth to young was to record the date that the litter was born and to destroy the young before they had a chance to suckle.

An analysis of the records of the 240 rabbits included in the series of studies mentioned showed that 21 rabbits gave birth to mature litters on one or more occasions. Nine of these 21 animals were in the group which was injected intratracheally with a measured dose of human tubercle bacilli, the 12 remaining, in the group which was injected with graded doses of bovine micro-organisms.

## RABBITS INJECTED INTRATRACHEALLY WITH HUMAN TUBERCLE BACILLI

These rabbits, 134 in number, may be divided into two groups, namely (1) those which were healthy prior to the intratracheal injection and in which primary tuberculosis developed, and (2) those which had been inoculated in the groin with an attenuated strain of tubercle bacilli (R<sub>1</sub>) and in which reinfection tuberculosis developed immediately following the intratracheal injection. All of the rabbits in both groups were injected intratracheally with a single dose (1 mgm) of human tubercle bacilli (H37). X-ray and necropsy examinations showed that the resulting lesions in the rabbits in both groups, though strikingly different in mode of development, were essentially retrogressive in nature. The lesions regularly progressed during the first, and part of the second, months following the intratracheal injection, and then, with a few exceptions, retrogressed leaving either no demonstrable lesion or only a small residual focus in the pulmonary parenchyma. Most of the rabbits were killed to permit of study of the lesions at different stages of the disease. Only 1 animal actually died of tuberculosis.

From the New York State Hospital for Incipient Pulmonary Tuberculosis, Ray Brook, New York

Four of the 76 rabbits which had primary pulmonary tuberculosis gave birth to young. The young arrived in every instance after the original abnormal shadows in the chest x-ray pictures had disappeared and when presumably the lesions were resolving or quiescent. One rabbit (No 199) gave birth to young on 3 occasions, in the third, fourth, and fifth months respectively following the intratracheal injection. Another rabbit (No 314) had a single litter in the fifth month. These 2 animals were killed in the sixth month at which time only small residual foci were found in the lungs. Of the 2 remaining rabbits, 1 (No 200) gave birth to 5 litters during the second year following the intratracheal injection and the other (No 201) gave birth to young on 6 occasions. The litters of the latter animal arrived in the fourth, fifth, ninth, eleventh, fourteenth, and twentieth months respectively. No lesions were found in the lungs of these animals when they were killed approximately 1 year and 9 months following the intratracheal injection. A comparison of the x ray and necropsy findings in these 4 rabbits with the findings in males and non-pregnant females failed to reveal any difference in the manner in which the disease developed and in the end results obtained.

Of the 58 rabbits which had reinfection tuberculosis, 5 gave birth to young. Two of these animals carried litters through the early phases of the disease. The 3 remaining gave birth to young during the later phases of the disease. One rabbit (No. 205) had litters in the first, second and third months, respectively following the intratracheal injection. Another animal (No. 208) had a single litter in the third month. Two (Nos. 212 and 38) of the 3 remaining rabbits gave birth to young on 1 occasion. The fifth animal had a litter in the twenty first month and contained several well developed fetuses when it was killed approximately 1 year and 10 months following the intratracheal injection. The x ray and necropsy findings in these 5 rabbits were, as far as could be ascertained, different in no wise from the findings in males and non-pregnant females similarly injected and killed at comparable periods.

#### RABBITS INJECTED INTRATRACHEALLY WITH BOVINE TUBERCLE BACILLI

These rabbits, 106 in number may like the above described animals be divided into 2 groups namely (1) those with primary tuberculosis, and (2) those with reinfection disease. Each of these groups in turn consists of animals injected intratracheally with a single dose of either 0.1 or 0.5 or 1.0 milligram of bovine tubercle bacilli (B1). X ray and necropsy studies of these rabbits revealed striking differences in the manner in which primary and reinfection tuberculosis develops and clearly demonstrated the rôle of dosage in both types of disease. The course of events in these rabbits was somewhat as follows. Lesions developed slowly in the lungs of the rabbits with primary tuberculosis rapidly in the lungs of the animals with reinfection disease. By the end of the fourth or the sixth week however the lungs of all of the rabbits contained large areas of tuberculous pneumonia. These pneumonic areas underwent a remarkable degree of resolution in succeeding weeks. The lungs of the rabbits injected with the smaller quantities of micro-organisms (i.e. 0.1 and 0.5 mgm.) frequently contained, by the end of the fourth or the sixth month, only minute residual foci. In a few of the rabbits, animals with reinfection disease induced by 0.1 milligram of bacilli these lesions remained quiescent for periods of 1½ to 2 years. These animals were killed. In most of the rabbits, however the residual foci gave rise after latent periods of a few months, to rapidly progressive pulmonary tuberculosis. All of these animals except those which were killed to permit of study of intermediate stages of the disease died of widespread tuberculosis.

Five of the 55 rabbits with primary tuberculosis gave birth to young on one or more occasions. Three of these animals were injected intratracheally with 0.1 milligram of micro-organisms, 1 with 0.5 milligram and 1 with 1.0 milligram. The 3 animals injected with the smallest dose of bacilli each had 1 litter. The litters arrived in the third, the fifth and the twelfth months. Two of the mothers (Nos. 356 and 470) were killed a few days after the young were born. The third mother (No. 393) was killed 1 year and 3

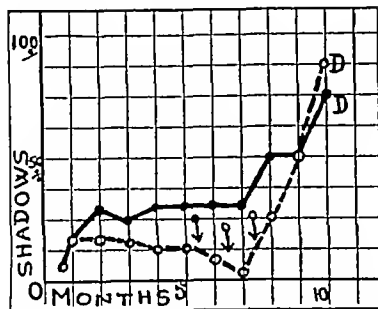


Fig 1 Primary tuberculosis 0.5 mgm B<sub>1</sub> Rabbit 377, male, rabbit 378, female

<sup>1</sup>In all figures axes of ordinates equal extent of abnormal shadows in percentage of lung fields of chest x ray pictures axes of absciss as equal interval following intratracheal injection in months

Male ——— female - - - - - birth of young ∅

months after the intratracheal injection. The rabbit injected with 0.5 milligram of bacilli (No 378) gave birth to 3 litters, in the sixth, seventh, and eighth months, respectively. The animal injected with 1.0 milligram of micro-organisms (No 115) contained several well developed fetuses when it was killed in the fifteenth month. A critical analysis of the x-ray and necropsy findings in these 5 rabbits and in non-pregnant females and males injected with similar quantities of bacilli, failed to show that pregnancy and parturition had significantly modified the course of the disease.

Figure 1 contains curves of 2 rabbits, obtained by plotting the percentage of the lung fields occupied by abnormal shadows against the interval following the intratracheal injection. The curve of the control animal, a healthy male (No 377) injected intratracheally with 0.5 milligram of bacilli on the same day as the female (No 378), is in solid lines. The

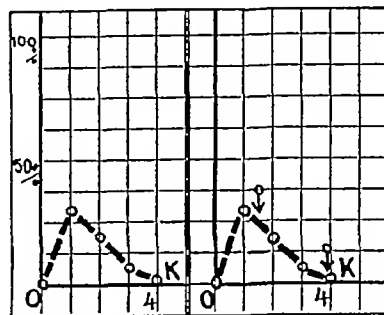


Fig 2 Reinfection tuberculosis 0.1 mgm B<sub>1</sub> Rabbit 433, virgin female, rabbit 432, female

curve of the female is in broken lines and circles. The arrows indicate the time at which the female gave delivery.

Young were born to 7 of the 51 rabbits with reinfection tuberculosis. Four of these 7 animals were injected intratracheally with 0.1 milligram of bacilli, 2, with 0.5 milligram, and 1, with 1.0 milligram.

The findings in the four rabbits injected intratracheally with the smallest dose (0.1 milligram) of bacilli were as follows. One animal (No 432) gave birth to a litter in the second month and was pregnant when killed in the fifth month. The x-ray and necropsy findings in this animal were similar to those in a non-pregnant female (No 433) which was killed at the same time. Figure 2 shows that the curves of these 2 animals are practically identical. Another rabbit (No 424) gave birth to young in the ninth month and was killed a few days later. Serial x-ray pictures of this animal disclosed that the disease, after undergoing marked retrogression, spread in the sixth month and again

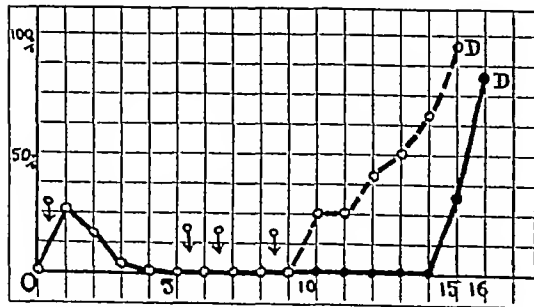


Fig 3 Reinfection tuberculosis 0.1 mgm B<sub>1</sub> Rabbit 345, male, rabbit 343, female

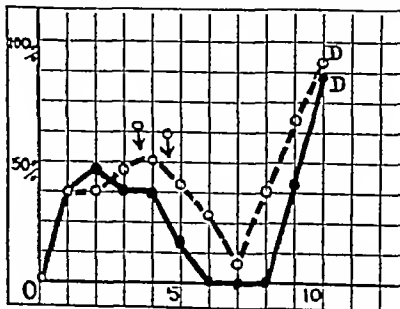


Fig 4 Reinfection tuberculosis 1.0 mgm B<sub>1</sub> Rabbit 388, male, rabbit 387, female

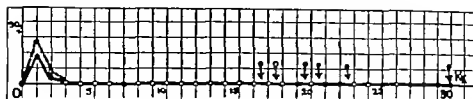


Fig 5. Reinfection tuberculosis. 5. mgm. B. Rabbit 340, male; rabbit 341 female.

in the ninth month. Necropsy examination revealed areas of gray consolidation studded with caseous foci and partially surrounded by fibrous tissue in both lungs. These lesions were comparable in every way to the lesions in the lungs of control animals killed soon after new shadows began to appear in the chest x-ray pictures. The third rabbit (No 343) gave birth to litters on 4 occasions and died of widespread tuberculosis 1 year and 3 months after the intratracheal injection. The x ray and necropsy findings in this animal were in all essentials, similar to the findings in some of the male rabbits injected with comparable quantities of the same suspension of tubercle bacilli. Figure 3 depicts the curves of this animal and of a male (No 345) which died at a comparable period. The fourth rabbit (No 341) gave birth to young on 5 occasions and was pregnant when killed. This rabbit, like a few of the male rabbits similarly injected failed to show any evidence of recrudescence of the disease. The animal was killed 2 1/4 years after the intratracheal injection. Necropsy examination disclosed a few small gray tubercles and minute scars in the left lung. These lesions were similar in all essentials, to the lesions in the lungs of a male rabbit (No 340) injected with a comparable quantity of the same suspension of bacilli and killed on the same day. The curves of rabbits No 341 and 340 appear in Figure 5.

One of the 2 rabbits injected intratracheally with 0.5 milligram of bacilli which gave birth

to young had 2 litters the other 10 litters. The former (No 372) gave birth to young in the eleventh and twelfth months and died of extensive ulcerative pulmonary tuberculosis approximately 1 year and 1 month following the intratracheal injection. The x ray and necropsy findings in this rabbit were similar to those in most of the animals injected in a comparable manner. The second rabbit (No 391) gave birth to litters in the first, second, third, fourth, sixth, seventh, eighth, ninth, tenth and eleventh months, respectively. This animal unlike all of the other animals similarly injected, failed to present any evidence of recrudescence of the disease. The animal was killed 2 years after the intratracheal injection, at which time only a few small areas of gray consolidation were found in the lungs. Figure 6 contains the curves of this animal (No 391).

The one rabbit (No 387) injected intratracheally with 1.0 milligram of bacilli which gave birth to young, had litters in the fourth and fifth months and died of widespread tuberculosis in the tenth month. The pregnancies, as far as could be ascertained from a study of the x ray and necropsy findings in this animal and in other animals similarly injected, had no effect on the course of the disease or the end results. Figure 4 contains curves of this animal (No 387) and likewise of a male animal (No 383) which had been injected with a comparable portion of the same suspension of bacilli.

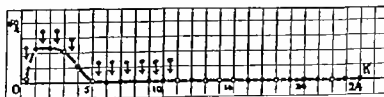


Fig 6. Reinfection tuberculosis. 5. mgm. B. Rabbit 39 female.

## SUMMARY

The experimental lesions in the lungs of the 240 rabbits, from which the 21 animals which form the basis for the present study were drawn, were, in many respects, similar to pulmonary tuberculosis in human subjects. They included lesions of primary and reinfection types induced by both human and bovine tubercle bacilli. The lesions in rabbits injected intratracheally with human tubercle bacilli were essentially retrogressive, those in rabbits injected with bovine micro-organisms were, with a few exceptions, essentially progressive.

Of the 21 rabbits which gave birth to young, some had one litter, others had several litters.

Young were born in early, intermediate, and late stages of both the essentially retrogressive and the essentially progressive forms of tuberculosis.

The present study failed to show any significant difference in the pathogenesis of experimental pulmonary tuberculosis in rabbits which did and did not give birth to young.

It seems reasonable, therefore, to conclude that pregnancy has no apparent effect on experimental pulmonary tuberculosis in rabbits.

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# THE PHARMACODYNAMIC EFFECTS OF CERTAIN OXYTICS UPON TUBAL CONTRACTIONS IN THE RHESUS MONKEY

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**I**n order to study the effects of oxytics several methods of assay have been devised. In some instances the activities of fragments of muscle removed from the excised uterus and continuously bathed in suitably oxygenated solutions, have been determined by attaching delicate hooks to the muscle and registering the contractions upon a smoked drum. In the living animal and in woman balloons have been placed within the uterine cavity and the pressure effects have been transmitted to the recording pen. In addition oxytics have been injected into the living animal and the visible effects upon the intact organs have been studied.

Generally when the methods in question have been employed the dynamic effects have not been measured in millimeters of mercury. Having the desirability of such measurements in mind during the course of other experiments upon the rhesus monkey we have recorded observations which it appears, are of interest respecting the strength of tubal and uterine contractions in this animal resulting from the administration of certain oxytic substances employed in obstetrics and gynecology. In the majority of instances, obstetrical pituitrin was employed but in a few cases thymophysin and ergotrate were administered.

The observations were made upon animals anesthetized with a solution of pentobarbital sodium, and in this connection a recent statement by Adair and Pearl is pertinent. The latter investigators in a clinical study found that this drug administered orally in 3 grain doses produced no appreciable change in uterine activity. Although there was a slight increase in the interval between the indi-

vidual contractions the general tone and the amplitude were unaltered and the tracings recorded showed as strong a uterine activity as before administration of the drug.

In our experiments the Voegtlin unit by which standard solutions are assayed was not used but we employed the standard solutions administered clinically. The dosage generally from  $\frac{1}{16}$  to 1 minims was increased to 7 minims in the case of one animal, and in all instances was injected intravenously by means of a tuberculin syringe. The apparatus employed to record the contractions was that used in the test for tubal patency. The effect of the drug was noted by the change in rhythm of the contraction relaxation waves produced by the passage of carbon dioxide through the uterus and tubes, while the variations in pressure were recorded upon the kymograph.

This brief paper is not intended to give a detailed report upon the effects of the substances mentioned since the observations are too few. Our wish is merely to record the possibility of using uterotubal insufflation as a medium by which with the aid of a kymograph it is possible to demonstrate the changes in pressure induced by the hypodermic injection of oxytics.

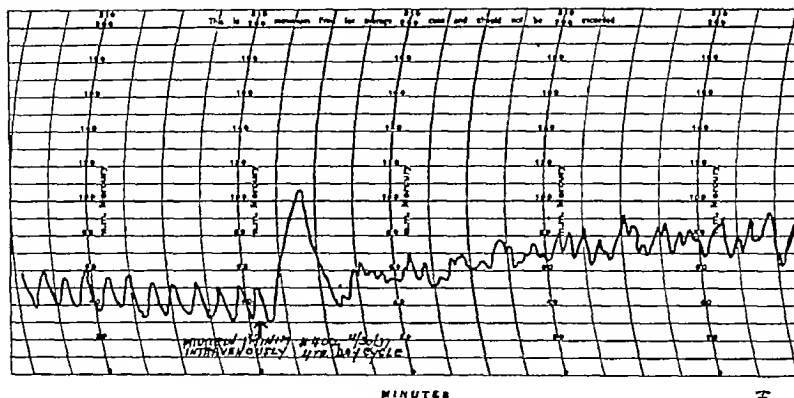
As far as our observations go we endeavored to note the latent period before the effect of the drug was exhibited the extent to which the peristaltic wave was affected the variation in the frequency and amplitude of oscillations when the contraction relaxation wave was not obliterated, the duration of the effect of the drug and finally how these effects squared with the Kraus-Ogino theory.

## DESCRIPTION OF TECHNIQUE

The uterine cervix was exposed according to a method previously described by us (2)

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Aided by grant from the Research Fund of the Yale University School of Medicine.



Graph 1

The cannula attached to a uterotubal insufflation apparatus was introduced into the uterine cavity and held firmly by Allis forceps grasping each cervical lip while pressing the obturating acorn against the cervical orifice to prevent leakage of carbon dioxide. The rate flow was as a rule limited to 3 to 4 minutes for the passage of 60 cubic centimeters of carbon dioxide. At this rate absorption of the carbon dioxide within the peritoneal cavity nearly approximated its insufflation rate and the abdominal cavity was spared voluminous distention when the procedure was carried out for 15 to 30 minutes or longer.<sup>1</sup>

It must be noted that the contraction-relaxation phenomena observed on the kymograph when carbon dioxide is passed through the uterus are generally synchronous with rhythmic contractions of the oviducts and only rarely with those of the uterus. During uterotubal insufflation, as has been proved conclusively by I C Rubin in the human and sow, S Wimpfheimer and M Feresten in the rabbit, and A H Morse and I C Rubin in the rhesus monkey, the uterus remains distended throughout the insufflation, its contractility being coincidentally paralyzed. Only when the carbon dioxide does not traverse the oviducts, but is allowed to regurgitate from the cervix at levels of pressure inadequate to overcome the resistance of the uterotubal junction are uterine contractions and relaxations procured.

<sup>1</sup>Marked abdominal distention can be relieved at once by introducing a No. 18 hypodermic needle into the peritoneal cavity.

Table I shows the number of observations upon each animal of the group and the day of the cycle upon which the experiment was performed.

TABLE I—OBSERVATIONS AND DAY OF CYCLE

Number of observations	Day of cycle
Animal 431—5	2-5-18-23-28
Animal 390—8	5-8-10-12-13-15-22
Animal 419—5	8-11-14-15-26
Animal 389—7	7-12-14-19-19-23-26
Animal 402—4	4-18-18-25
Animal 373—1	7
30	

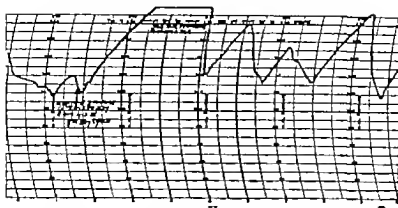
In each of animals 389, 390, and 402 experiments were done upon corresponding days during two different cycles.

#### ANALYSIS OF RESULTS

Thirty observations were conducted and the accompanying curves were selected from the kymographic recordings obtained. In most instances the contractions and relaxations registered during carbon dioxide uterotubal insufflation are manifestations of tubal but not of uterine muscular activity.

The latent period before the effect of the injected pituitrin was observed varied in the different animals and in the same animal upon different trials. In the accompanying graphs it will be seen that the interval from injection to effect was from 30 to 40 seconds. However, during other experiments, the tables and graphs of which have been omitted, we found



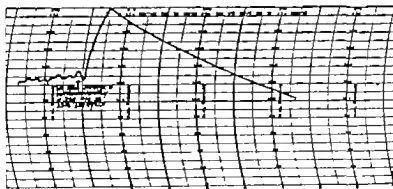


Graph 1.

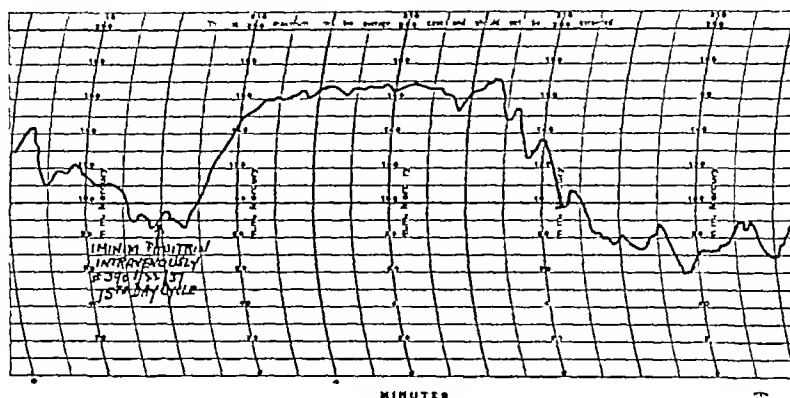
the shortest interval to be 2 seconds and the longest 2 minutes. In the same animal the rapidity of reaction varied from 15 seconds to 2 minutes. In general the effect was produced within 15 to 68 seconds of the injection. No definite relationship between the oxytocic effect and the phase of the cycle was apparent. The duration of the effect likewise varied in the same and in different animals and again was independent of the phase of the cycle. Thus in animal 402 Graph 1 the effect of 1 minim of the drug was prolonged approximately 1 minute after which there returned atypical tubal contractions as contrasted with the rhythmic waves which were present before the administration of pituitrin. In animal 389, Graph 3 the effect of 2 minims persisted for  $3\frac{1}{4}$  minutes during which tubal contractions were inhibited. In animal 390

Graph 4, tubal contractions returned  $1\frac{1}{2}$  minutes following the intravenous injection of 1 minim of the drug but a pressure of 160 to 170 millimeters mercury was maintained for  $3\frac{1}{4}$  minutes. At the end of this period there was an intermittent drop when the contractions resumed the character noted before the injection. Study of our numerous curves showed the shortest duration of effect to be 3 minutes the longest 26 minutes, and the average from 3 to 15 minutes.

The pressure elevation measured in terms of millimeters of mercury varied considerably in the same and in different animals without exhibiting any striking trend with reference to the first or second half of the cycle. In animal 402 Graph 1 there was a rise from 50 to 105 millimeters of mercury in animal 49, Graph 2 a rise from 130 to 300 with com-



Graph 2.



Graph 4

plete obliteration of the tubal contractions noted before the injection, in animal 389, Graph 3, a rise from 125 to 208, in animal 390, Graph 4, a rise from 86 to 165 millimeters of mercury. In the complete series of experiments, the average elevation of pressure following the injection of pituitrin varied from 40 to 92 millimeters of mercury.

The observations respecting the oxytocic effect of thymophysin were too few to warrant conclusions. Only one definite effect was noted in four trials in as many different animals. Two experiments with ergotrate were without effect.

#### CONCLUSIONS

The method of uterotubal insufflation with the aid of the Lymograph as employed for the diagnostic test of tubal patency, has been utilized to determine the oxytocic effects of

pituitrin, thymophysin, and ergotrate upon the oviducts of the rhesus monkey. The pharmacodynamic effects have been measured in terms of millimeters of mercury and the duration of the effect, and the influence of the drug upon the character of tubal contractions have been studied. An advantage of the method is the possibility of determining oxytocic effects upon the intact tubes and uterus in the living animal.

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# CLINICAL SURGERY

## RESECTION OF A PORTION OF THE THORACIC ESOPHAGUS FOR CARCINOMA

### A Report of Two Cases

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THE purpose of this paper is to report a case of carcinoma of the thoracic esophagus which were operated upon by the technique of Torek, to suggest an additional step in his procedure, and to offer a means of controlling the esophageal fistula which is a sequel of the operation. In Figures 1 to 9 an attempt is made to illustrate the operation more clearly than has been done in the past.

#### CASE REPORTS

**CASE 1.** C. E. Clochmann General Hospital No. 2394. A 60 year old male laborer entered the medical service of the Clochmann General Hospital on January 2, 1934, with the chief complaint that he had been unable to swallow either liquid or solid food for 3 days.

Six months prior to entry into the hospital the patient suddenly felt that "solid food would not go down." Following this he noted progressive but intermittent dysphagia. At first he was able to eat soft food and puréed vegetables, but as meat or heavy foods would pass. Then suddenly he could have difficulty in swallowing liquids. These attacks would come and go for period of 3 months. At times he would be able to swallow without any difficulty whatsoever for 3 or 4 days, and then the esophagus would suddenly shut off and he could be to swallow whatever he ate. For several weeks prior to entry he was able to take only liquids and soft boiled eggs, when suddenly he was unable to swallow anything. 1 1/2 months his weight fell from 142 to 120 pounds.

The patient was markedly dehydrated and emaciated residue of fat had been fairly well developed male of 60. He was alert and well oriented. The following were the only positive findings. The mucutaneous tissues showed evidence of marked dehydration. There was no anorexia. The mucous membranes were of good color. The 4 remaining teeth were very carious. The chest was emphysematous in type. Heart and lungs, physiological. Blood pressure was 115/80. Brachial and radial vessel walls showed moderate amount of atherosclerosis. The liver edge was palpable just at the costal margin. The spleen and kidney were not palpable.

The red blood cells numbered 4,600,000 like corpuscles, 100 hemoglobin, 5 grams. The urine was negative except for occasional granular and hyaline casts. Wassermann reaction was negative, x-ray, malignancy.

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per 100 cubic centimeters, carbon dioxide, 49 volumes per cent.

X-ray examination revealed an irregular obstruction in the esophagus at the level of the ninth dorsal vertebra. This was practically complete, only thin trickle of barium passing into the stomach. Esophagoscopy was done, and an obstruction met the fingers from the lachar vertebra. An irregular ulceration was seen at the point of the obstruction and biopsy was taken from it. The first biopsy was unsatisfactory but second one showed the tumor to be squamous cell carcinoma.

The patient was given parenteral fluids and transferred to the surgical service where January gastrostomy was performed January 24, 1934. There were no nodules in the liver and no glands were noted as the lower curvature of the stomach. The postoperative course was unremarkable. The patient gained 4 pounds in weight. A left sided pneumothorax was instituted. The patient was transferred with 500 cubic centimeters diluted blood.

On February 1934, under cyclopropane anesthesia, the left pleural cavity was entered through long incision made in the seventh intercostal space, extending from the nipple line to the lateral axillary region and then up to the region of the third rib. The seventh, sixth, fifth, and fourth ribs were cut near their attachment to the spine. After mobilizing the left lung from many old like adhesions, the phrenic nerve was crossed and an incision was made through the parietal pleura over the esophagus from the aortic arch to the diaphragm. My sharp and blunt dissection the esophagus was freed from the aortic arch to the diaphragm. The right vagus nerve was quite adherent to the tumor and many branches had to be sacrificed. The left vagus nerve was readily freed from the tumor. The tumor was found to be quite small and to lie at the junction of the middle and lower thirds of the esophagus. The diaphragm was not opened widely. The esophagus was divided between pursestring ligatures of silk, and an attempt was made to invert the esophagus into itself. The pursestring tore out and suturing occurred. Inversion was finally accomplished but with difficulty and more suturing. The proximal stump was carbonized and protected with gutta serena, which was tied over the end of the esophagus with braided silk. The esophagus was then separated above and below the arch of the aorta by sharp and blunt dissection. This dissection was then carried further up into the region of the suprasternal notch. A small incision was made through the skin and pleura in this region. Cutting down against finger which was pushing into the suprasternal notch from within the chest, the thoracic cavity was entered. The esophageal stump was then brought out through the incision in the neck and allowed to hang down the anterior chest wall. The thorax was then closed with 3

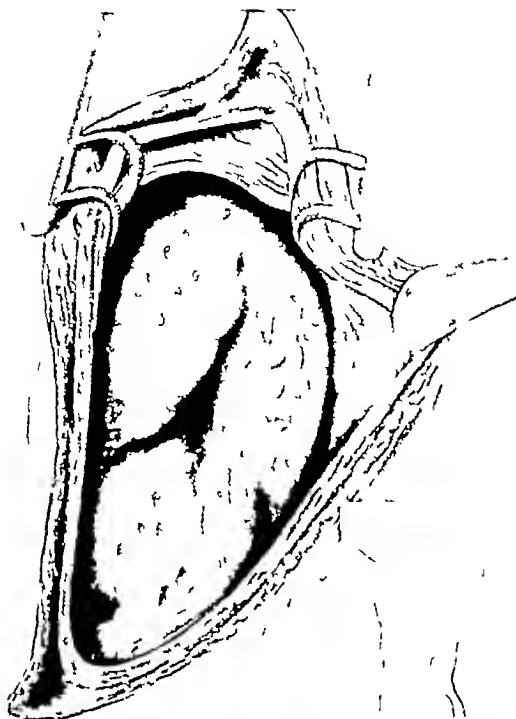


Fig 1 The exposure on opening the thorax. The dotted lines show the incision in the pleura overlying the esophagus. The course of the skin incision is shown in the insert.



Fig 2 The esophagus has been freed by sharp and blunt dissection from the diaphragm to the lower margin of the tumor and from the aortic arch to the upper margin of the growth.

pericostal silver wires following inflation of the lung by means of positive pressure. The muscle layers were approximated with a running suture of No. 2 chromic catgut. The skin was closed with interrupted sutures of fine silk. Returning to the esophageal stump, a skin tunnel 4 centimeters long was made connecting an incision in the second interspace with that in the suprasternal notch and the esophagus and attached tumor brought through it. The excess portion of the esophagus containing the carcinoma was then removed and the edges of the esophagus sutured to the edge of the skin incision with fine silk. The patient received 1500 cubic centimeters of blood during the operation, but stood the operative procedure quite well and was returned to the ward in good condition.

The gross specimen consisted of a section of esophagus 6 centimeters long. The wall was  $1\frac{1}{4}$  centimeters in thickness. There was an annular constricting ring at one end, which was hard and nodular and composed of neoplastic tumor. No fungating mass was found.

Microscopic sections showed that the normal structure of the wall had been partially destroyed by neoplastic growth. The cells of the growth were rather large and moderately dark staining. They were arranged in indefinite layer sheets and sometimes in whorls. There was fair cellular differentiation and mitotic figures were not numerous, suggestive of a rather slowly growing tumor. Much of the muscularis was still intact and some normal glands could be found. In addition to the tumor formation there was also an inflammatory process, manifested by the presence of round cells closely packed in certain focal areas.

Twenty four hours after operation the patient's temperature rose to 105 degrees (rectal), pulse to 132, and respirations to 26, and he began to raise large amounts of

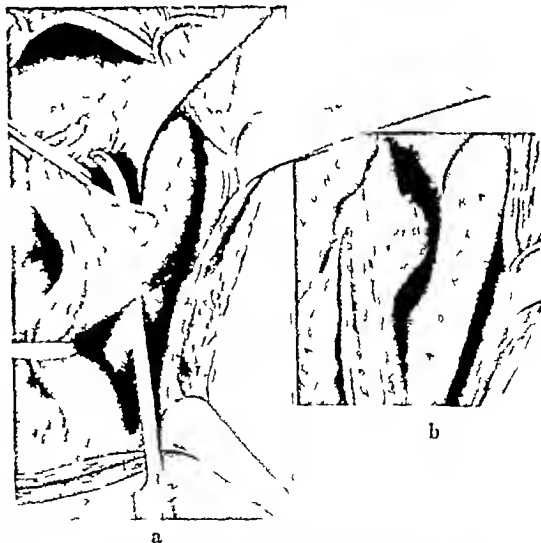


Fig 3 a, The growth is being dissected off the aorta. b, The growth has been completely freed from the aorta.

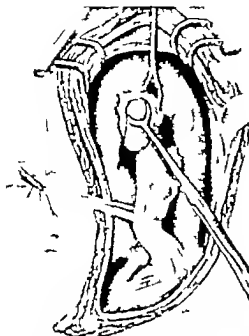


Fig. 4. The esophagus is being freed by blunt dissection from under the aortic arch. Several small arteries enter the esophagus here and must be isolated and ligated separately.

thick tenacious sputum. A diagnosis of atelectasis of the left lung was made, which cleared promptly. With hyper-ventilation, turning of the patient, and encouraging him to cough, so that his temperature dropped to 100 degrees, pulse to 85 within hours.

Within 48 hours after operation the patient, on taking his hourly gastrostomy feedings. The temperature ranged around 99 to 100 degrees for 6 days. X-ray examination at this time revealed a rather uniform increased density of the left hemithorax, which was interpreted as consolidation of atelectasis with associated pleural effusion. On aspiration 30 cubic centimeters of straw-colored fluid, from which hemolytic streptococci were cultured, were removed. Several subsequent cultures of aspirated fluid were negative. A low-grade infection developed in the lower third of the esophagus. On March 20, 1938, the patient developed an intractable diarrhea. Gastric analysis showed no free or combined hydrochloric acid. The addition of 1 cubic centimeter of tenth normal hydrochloric acid to each feeding completely checked the diarrhea. On March 25, 1938, closed thoracotomy for streptococcus empyema was done and on March 30, 1938, rib resection was performed in order to drain the remaining empyema cavity more adequately.

Three weeks after operation feedings were begun by mouth, the esophageal stoma and the gastrostomy being connected by rubber tube. Considerable leakage occurred around the tube, and an intratracheal catheter with balloon attachment was used in the stomach and sealed cryostat-ically (Fig. 5). The patient was up and about and enjoyed his food by mouth. Suddenly on April 12, 1938 the patient's temperature rose from normal to 101 degrees and pulse from 80 to 116. On April 16, 1938, left-sided weakness developed, which within 6 hours became total left-sided hemiplegia. His neck became stiff shortly before death. The patient's pulse accelerated, his stupor increased, and the patient died at 1:30 p.m.

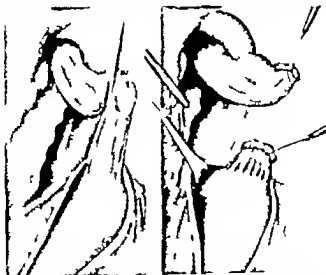


Fig. 5. The diaphragm has been opened widely and dissected free from the stomach and esophagus. Through this exposure it is possible to remove involved glands along the lesser curvature. Note that the peritoneal suture has been placed in the stomach rather than in the esophagus.

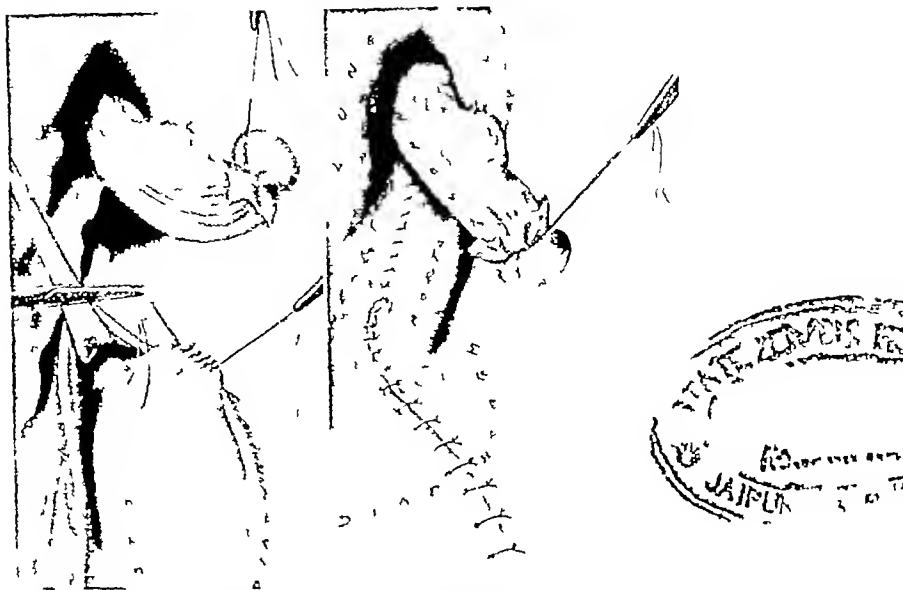


Fig 6 The pursestring suture in the stomach has been inverted beneath Lembert sutures of silk. The diaphragm has been closed, as has the parietal pleura

An autopsy was performed. Multiple small multilocular lung abscesses and areas of atelectasis were found in the left lung. An early lobular pneumonia and chronic pulmonary emphysema were noted. A small encapsulated empyema cavity was present in the left pleural cavity. A lymph node 2 centimeters in diameter was found at the cardiac end of the stomach on the lesser curvature, which on section showed carcinoma, but there was no evidence

of any other metastases. The brain showed no abscess, but there was a well marked basilar meningitis with ependymitis.

The pleural cavity was not drained by means of catheters at the end of the operation. This was an error in judgment, especially in view of the



Fig 7 The esophagus has been freed above the aortic arch up to the root of the neck and has been pulled up from behind the arch

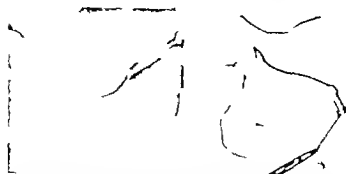


Fig. 2, a, left. An incision is being made in the suprasternal notch. Note the bulge in the notch which is caused by the finger lifting the thorax, pressing the tissues forward. b, The esophagus has been pulled out through the incision in the suprasternal notch.

fact that soiling had occurred when the purse-string suture tore out of the esophagus. Drainage of the pleural cavity I believe, should always be done for it (1) removes (by constant suction attached to the catheters) the bloody fluid which acts as a good culture medium for bacteria and (2) promotes complete expansion of the lung.

The purse-string suture beneath which the distal stump of esophagus was inverted was placed in the esophagus rather than in the stomach. This should never be done for it is difficult to place the suture in the esophageal wall so that it will not tear out when the attempt is made to invert the esophagus into itself. If placed in the stomach the suture holds more firmly and it is much easier to invert the esophageal stump into the larger stomach rather than into itself. The soiling which resulted when the suture tore out was responsible for the empyema and for the wound infection.

The involved lymph gland near the hiatus of the lesser curvature of the stomach was missed largely because the diaphragm was not opened. It was the only site at autopsy in which metastasis was found and its removal had the patient lived, would have made the difference between a possible cure and a certain failure.

CASE 2. A M. Cincinnati General Hospital No. 899. This man 55 years of age entered the hospital on March 7, 1930, complaining of inability to swallow. His first noted difficulty in swallowing was a week before admission when, while eating an orange, he felt something stick in his gullet just beneath the sternum. There was moderate pain beneath the sternum and feeling of fullness there also. During the week prior to admission he had been able to swallow only small portions of soft food and small amounts of liquids, and had lost 6 pounds in weight. The past history was negative except for chronic alcoholism and for loss of many years' duration.

The patient, as then, called man, appearing to be about 60 years of age. There was evidence of recent loss

of eight. Mentally the patient was well oriented, but as dull and apathetic. His temperature was normal, his pulse was 80, and his blood pressure 115/80. There was nothing remarkable about the general physical examination. The Wassermann was positive.

Röntgenograms after ingestion of barium showed an obstruction in the esophagus at the level of the eighth dorsal vertebra. This obstruction seemed round in that the opaque mass appeared to pass around a circumscribed rounded mass. The röntgenologist suggested that the obstruction might be due to a bolus of food. However, esophagoscopy showed an ulcerated, thickened area in the mucous membrane of the esophagus. 35 centimeters from the incisor teeth and biopsy from this area showed squamous cell carcinoma, grade 2. After esophagoscopy the patient could swallow easily and well and left the hospital saying he could return in a few days. He returned at the end of 3 weeks, having lost pounds and being unable to swallow anything but small amounts of liquids.

On April 22, 1930, gastric gastrostomy was performed under local anesthesia. There were no palpable nodules in the liver but a small gland could be felt along the lesser curvature of the stomach near the esophageal hiatus. The gastrostomy functioned well and the frequent feedings of high caloric diet and vitamins the patient gained 3 pounds in eight and improved in strength and appearance. A complete artificial pneumothorax was induced in the left pleural cavity.

On May 8, 1930, portion of the thoracic esophagus was resected. Under cyclopropane anesthesia an incision was made along the course of the left seventh interspace from the nipple line to the posterior axillary line where it is curved upward and between the scapula and the spine to the third rib. This incision was deepened down to the pleura and such segments of the rib as the ends of the seventh, eighth, ninth, and fourth ribs were resected. The pleural cavity was entered in the seventh interspace, and the chest was spread widely with rib spreaders. A rounded tumor mass 4 centimeters long and 3 centimeters wide was found in the esophagus about 3.5 centimeters below the aortic arch. There were no enlarged glands in the mediastinum. The phrenic nerve was crushed and long incision was made through the parietal pleura over the esophagus from the aortic arch to the esophageal hiatus in the diaphragm. By sharp and blunt dissection the esophagus was freed from the diaphragm to the lower limits of the tumor. The esophagus was similarly freed from the aortic arch to the upper limits of the tumor and tapes were passed about the

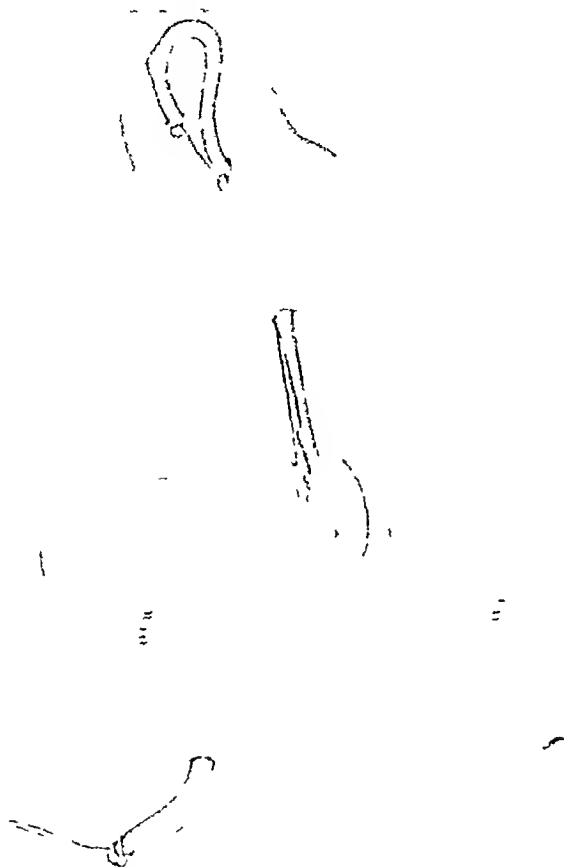


Fig 9 A short transverse incision has been made in the second interspace (higher if necessary) and a tunnel formed communicating with the neck incision. The esophagus is drawn through this tunnel, the tumor amputated with a good margin, and the edge of the esophagus sewed to the skin.

esophagus above and below the tumor. The tumor was adherent to the aorta but not densely so and by sharp dissection was freed from it.

The diaphragm was widely opened from the esophageal hiatus laterally for about 4 inches and freed from the stomach and the esophagus. One small hard gland was found on the lesser curvature close to the esophageal hiatus. This was removed. A pursestring suture of silk was placed around the cardiac end of the stomach just below its junction with the esophagus. The esophagus was divided between pursestrings of silk just before it entered the stomach. The lower end of the esophagus was inverted into the stomach beneath the pursestring and the latter was inverted beneath four Lembert sutures of silk. The lower end of the remaining upper portion of the esophagus was covered with a piece of rubber dam which was tied tightly with a piece of braided silk.

The esophagus was freed from beneath the aortic arch, where it was necessary to ligate two large vessels which entered the esophagus. The vagus nerves could be dissected off the tumor and the esophagus, only a few small branches having to be sacrificed. The esophagus was then

freed by blunt dissection up to the level of the suprasternal notch. The operator's left hand was placed within the thorax and the index finger was pushed into the suprasternal notch. Within the right hand an incision 2 inches long was made over this finger in the notch, and a curved clamp was introduced through the incision down into the thorax. The braided silk ligature on the end of the esophagus was grasped with the clamp and the esophagus with the tumor attached pulled out through the neck incision.

The thorax was closed with 3 kangaroo tendon pericostal sutures, a continuous suture of catgut in the muscles, and interrupted silk sutures in the skin. Two mushroom catheters were introduced into the chest before it was closed, one in the sixth interspace in the nipple line and one in the eighth interspace in the midaxillary line. After the wound had been closed the left lung was completely inflated, and the catheters were clamped off. A short transverse incision was made at the level of the second interspace close to the left border of the sternum, and a subcutaneous tunnel was made up to the neck incision. Through this tunnel the esophagus and tumor were drawn. The esophagus was now divided well above the tumor, and





Fig. 6. a, left Intratracheal catheter with balloon deflated. b Intratracheal catheter with balloon inflated.

its edges were united to the skin edges with interrupted silk.

The operation lasted 3½ hours. During the procedure transfusion of 500 cubic centimeters of blood was given, and a second 500 cubic centimeters of blood was given at the completion of the operation. The patient's condition was good throughout the procedure.

The gross specimen consisted of a segment of the esophagus, 10 centimeters long, containing an ulcerated tumor which extended around two-thirds of the circumference of the esophagus and for a distance of 8 centimeters in its long axis. The microscopic picture was identical with that of the biopsy.

The convalescence was smooth, all the wounds healing *per primam*. There was little drainage from the catheters for the first week, at which time the anterior one was removed. After a few days the remaining catheter began to drain thick fluid, which on culture showed staphylococcus aureus and streptococcus. Drainage of this purulent ma-

terial continued for a month after operation, at which time there was no empyema clinically remaining.

For many weeks the patient, as most cases operate, and refused food through the gastrostomy on many occasions with the result that he failed to gain in weight and strength. Finally in October, 1930, he began to show reversal of interest in life and from that time on he gained 5 pounds and looks now very well.

At first the intratracheal tube with balloon attachment was used in the esophageal fistula. Later an esophageal catheter cut off as in Figure 7 was used. This cured an area of skin slough and had to be discontinued for several weeks, all feedings being taken through the gastrostomy opening.

In November, 1930, an antethoracic skin tube was begun to join the esophageal fistula with the gastrostomy. This is being done in stages and is nearly complete. Its completion is delayed by the necrosis due to the esophageal catheter and to the appearance of a nodule about 5 centi-

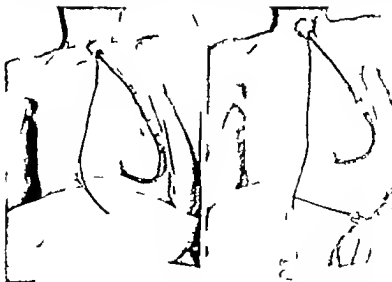


Fig. 7. a, April 6, 1931, left Intratracheal catheter in stomach and attached to gastrostomy tube. The balloon is deflated. b The balloon inflated.

meters in diameter in the subcutaneous tissue about 1 centimeter proximal to the mouth of the esophageal stoma. This was felt to be carcinoma and proved so on biopsy, so in March, 1940 (10 months after operation) the lower 2 inches of the upper stump of esophagus were resected and the stoma moved upward for that distance. One other small subcutaneous nodule was removed along with the resected portion of the esophagus. It is hoped that the skin tube can be completed within the next 6 weeks.

The small empyema which occurred did not appear until 10 days after operation and may have resulted from leaving the drainage catheter in the thorax too long after operation. Cultures of the aspirated fluid did not show any organisms for the first week after operation. All the wounds healed *per primam*.

The occurrence of the two small nodules of carcinoma in the subcutaneous tissue near the stoma in the second interspace 10 months after operation was most probably due to implants of carcinoma which occurred when the esophagus with the tumor attached was pulled through the subcutaneous tunnel. In the future it is planned to resect the tumor bearing area with a good margin before the esophageal stump is pulled through the subcutaneous tunnel.

By making a wide opening in the diaphragm a small involved gland was removed from the lesser curvature and also a good inversion of the lower esophageal stump with the stomach could be attained without soiling, due to the purse-string suture having been placed well down on the stomach.

A frequent site of glandular metastasis in carcinoma of the esophagus is the glands along the lesser curvature of the stomach close to the esophageal hiatus. These glands may be palpable at the time the preliminary gastrostomy is done but if they are not fixed their presence should not be a contra-indication to the resection of the esophagus. Their removal, however, if this is feasible, is essential to the cure of the carcinoma of the esophagus. The resection of these glands by the transabdominal route through which the gastrostomy is done is very difficult and well-nigh impossible. However, one has ready access to them through the diaphragm at the time the transthoracic resection of the esophagus is being done. We have had this experience in 2 cases in which esophagogastrostomy has been done for cancer of the lower esophagus. It would seem logical, therefore, that one should open the diaphragm widely at the time the Torek resection is being done, free the lower esophagus and cardia, and remove any glands which are present along the lesser curvature. This opening of the diaphragm to obtain this exposure gives one an op-

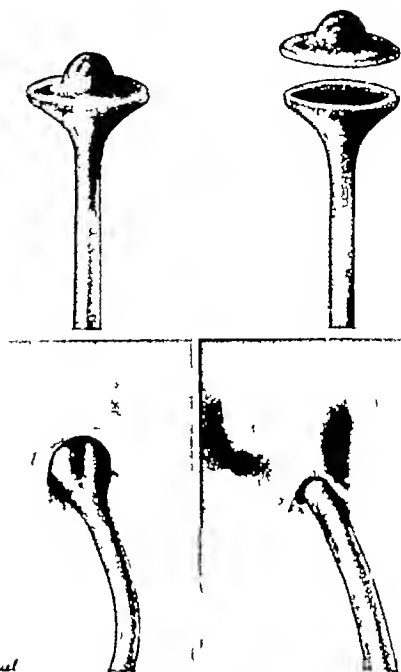


Fig 12 The end of a mushroom catheter has been cut off and the folded catheter introduced into the esophageal stoma. The end of the catheter then unfolds itself and gives a snugly fitting tube.

portunity to place the pursestring suture, through which the lower stump of the esophagus is inverted, into the firm stomach wall, where it holds much better than if placed in the more friable tissue at the junction of stomach and esophagus. Failure to place this pursestring suture in firm stomach wall resulted in its tearing out in our Case 1 and in soiling which was responsible for the subsequent empyema.

In both cases reported here Torek's original technique was used in dealing with the upper stump of the esophagus. He freed the esophagus up to the root of the neck from within the thorax and then made a short incision to the left of the suprasternal notch, through which he pulled the esophageal stump. This procedure seems preferable to making an anatomical dissection of the esophagus in the neck through a cervical incision for it is less time consuming and what is more important, it does not interfere so much with the blood supply to the freed esophagus. The blood supply to the upper end of the esophagus was excellent in both of our cases, and healing without infection took place rapidly between the skin and the esophageal mucous membrane.

The management of the esophageal fistula which results from the open end of the remaining esophagus may be very troublesome. The chief difficulty which has been encountered in the 3 cases herewith reported has been leakage of saliva and food around the tube which has been placed in the open end of the esophagus and by which this open end is joined to the gastrostomy opening. This leakage is especially liable to occur in the first few weeks after operation, for at this time there is little contracture of the tissues surrounding the fistulous opening, and as a result there is no constriction present which will hold a tube and prevent leakage. It is well known that as soon as the patients begin to swallow saliva they begin to improve and gain in weight. Consequently any means which will promote the early swallowing of food and saliva without leakage is very helpful in the postoperative care. With this in mind we have introduced an intra tracheal catheter with a balloon attachment into the esophageal fistula and gently inflated the balloon (Figs. 10 and 11). This gives snugly fitting indwelling tube about which there is little leakage and which may be left in place for many hours without the danger of pressure necrosis. The disadvantage of the balloons is that they are rather delicate, soon wear out, and are expensive to replace. We have attempted to have sturdier ones made but thus far have been unsuccessful, largely through lack of interest of the manufacturers. Later in the patient's convalescence when scarring and contraction of the mouth of the fistula have occurred we have used a mushroom catheter cut off as shown in Figure 12. This works very well but it must be changed and the skin watched for pressure necrosis which occurred in one of our cases, due to the introduction of too large a mushroom.

The Torek operation combined with the removal of the lymph glands along the lesser curvature appears to be the procedure by which the

carcinoma of the esophagus can be most completely and thoroughly removed. A wide margin can be given to the tumor and local recurrence should not occur. It would seem to be the operation of choice for tumors of the intrathoracic esophagus, occurring anywhere from just within the thorax down to the lower one third. For the cancers of the lower one-third of the esophagus a resection of the growth and the performance of an esophagogastrostomy is most ideal. The danger of the esophagogastrostomy, however, is that one may be so anxious to perform it that an insufficient length of esophagus is resected and local recurrence will take place. Unless a satisfactory margin can be given the growth, i.e. at least an inch and a half above the upper limits of the tumor it is safer to abandon the idea of an esophagogastrostomy and perform the Torek operation. Although the stomach can be mobilized and brought high up into the thorax, the technical difficulties of performing the anastomosis beneath the aortic arch are so great as to preclude its performance.

#### SUMMARY

1. Two cases of carcinoma of the middle third of the esophagus treated by resection according to Torek, a method are reported.

A wide incision through the diaphragm in order to remove involved glands along the lesser curvature and to permit a satisfactory inversion of the distal stump of the esophagus into the stomach is advocated.

3. A method of dealing with the esophageal fistula is given.

4. For the complete removal of the majority of carcinomas of the thoracic esophagus, the Torek procedure is the most satisfactory. Esophagogastrostomy finds its greatest field of usefulness in the treatment of carcinoma of the cardiac end of the stomach or of carcinoma in the terminal esophagus.

# A HEAD INJURY SURVEY

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THE case records of patients admitted to the Los Angeles County Hospital with a head injury problem during the 6 years from July, 1928, to July, 1934, have been reviewed. The important points from the consequent statistical tables are here presented as a gross summary. More detailed accounts of individual cases and groups of cases have been and will be used in other papers.

There were 5,912 cases. Major cases, 1,969, or 33.3 per cent, comprise all those with definite cerebral damage with or without skull fracture, all cases with skull fracture, and all cases which developed complications. Minor cases, 3,943, or 66.6 per cent, were those with little evidence of brain injury and no skull fracture. Of the major cases 546, or 9.2 per cent of the total, 27.7 per cent of the majors, were so classified because of skull fracture only, as there was no apparent serious brain injury. These and the minor cases, totaling 4,489, or 75.8 per cent, required only bed rest and general care. The 1,423 remaining, or 24.2 per cent, are those in which a brain injury was evident, or which developed complications or required operation.

The fact that 75.8 per cent of all head injury patients recover without special treatment gives a false sense of security, tending to throw the other 24.2 per cent into a class of cases in which the results, either death or disability, are accepted as a matter of course, and therefore a number of cases in the smaller group which might be saved are overlooked.

**Deaths.** There were 445 deaths, 7.5 per cent of the total and 22.6 per cent of the majors.

**Age.** The average age for the major cases was 33.13 years, for the minors 33.5 years. Age has been charted against all injuries and all deaths. By comparing the two charts in Figure 1 the number of deaths for each age can be seen. The highest number of deaths—22—for an age is seen at 50 years. The injury chart shows 101 cases at that age, thus a 21.5 per cent death rate. At age 21 there are 6 deaths in 149 cases, a 4 per cent rate for that age. Ratio of death is thus shown for each age.

**Manner of injury.** Figure 2 shows manner of injury and the etiological factors related to age.

Neurosurgical Service, Los Angeles Orthopaedic Hospital and Good Hope Hospital Association Clinic.

In this chart each co-ordinate in the horizontal line represents one year. The height of the column in each instance represents the number of cases in that age. The co-ordinates left unfilled, which show themselves as indentations from the base line, are the number of each age recorded as suffering from acute alcoholism. In "auto-pedestrian" and in "falls" one finds the result of the carelessness of immaturity and that of old age. In "assaults" and "auto-collisions" one finds the result of the carelessness of vitality. Attention is called to the pairing of these chartings.

✓The total number of automobile accidents was 3,604 or 61 per cent of all cases. Falls accounted for 940, or 15.92 per cent, assaults, 687, or 11.63 per cent, miscellaneous causes, 242 or 4.1 per cent, motorcycle accidents, 110 or 1.86 per cent, and in 323 cases, or 5.4 per cent, there was no history.

**Manner of injury and death.** The death rate of "auto-pedestrian" was 9.1 per cent and "falls" 9.5 per cent. These were high compared with a 6.3 per cent rate for auto collisions. Auto-pedestrian and fall injuries occur more frequently among the aged and the immature, and the aged especially, when injured, are less likely to recover. Also, the mechanism of brain injury in a fall or auto-pedestrian accident has a greater component of the "head-movement-suddenly-stopped" factor (5).

**Hospital days.** The average hospital stay for all cases was 13 days for major cases, 16 days, and for minor cases, 11.4 days. The longest stay among the major cases was 289 days (complications) the shortest 1 day (death). In the minor cases the longest stay was 270 days (other injuries) the shortest 1 day (patients who left without consent or transferred to other hospitals).

Many of the patients left of their own accord after signing a release of responsibility, and complete follow-ups were not obtained. To be perfectly safe in any head injury case, even without apparent serious brain damage, a 14 day bed rest period should be required. The averages found are the desirable basic requirements in treatment (14, 24).

**Hospital days and infection.** There were 20 cases of scalp infection and 6 of these had osteomyelitis. The average of hospital days for these

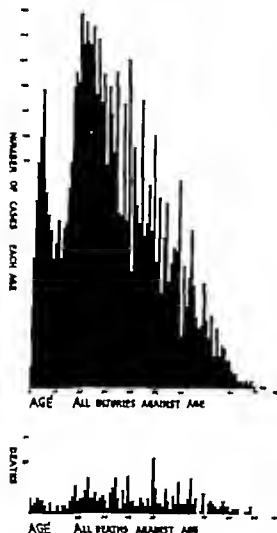


Fig. 1. Comparison of number of injuries and deaths for each age.

infections was 49. The structure of the scalp is such that the wounds most often appear as lacerations which, when sutured, should heal *per prius*. However scalp bleeding is so severe that suturing is often done without adequate cleansing underneath. Several cases of scalp infection when reopened for examination or elevation of a depressed skull fracture showed hair and foreign substances which were exposed only when the original laceration was enlarged. These cases caused our longest periods of hospitalization.

*Hospital days and death.* Of the deaths 51.7 per cent occurred on the first day 79 per cent had

occurred by the fifth day 90.4 per cent by the eleventh day. It is strongly felt that movement reduces the chances of recovery (6, 13) as do also extensive emergency repairs. A number of cases were found in which the condition might not have become so serious had the patients been kept absolutely quiet after the accident, and movement to both emergency station and general hospital delayed. A high percentage of first day deaths is undoubtedly caused by the original injury but the reactions to the injury are probably responsible for an equally high number and these reactions are increased by movement, administration of fluids, and surgical procedures.

✓ *Unconsciousness.* There were 2,979 patients unconscious, or 50.3 per cent of 5,912. Of these 1,040 were major cases or 52.0 per cent of 1996. In a large number of cases the duration of unconsciousness was not stated, short and "long" being as nearly accurate as circumstances allowed. Unconsciousness carried a death rate of 28.3 per cent "time not stated," 45 per cent. "short time" 3.9 per cent "long time" 50 per cent "intervals" 71 per cent. Under unconsciousness of one day the death rate was 79.8 per cent. These deaths undoubtedly include all of the cases in which death occurred on the first day. The figures concerning minutes and hours are too complicated for this gross summary. ✓

In the semiconscious cases the death rate was 17.8 per cent as compared with a rate of 28.3 for unconscious patients. In time not stated there is a 30.6 per cent death rate as compared to a 45 per cent rate for unconscious patients. The few labeled "short" among the semiconscious carried no death rate as compared with a 3.9 per cent rate for "short" unconscious patients. ✓

The combined unconscious and semiconscious data indicated that an unconscious patient who awakens to a rational state has a much better chance for recovery than one who awakens to semiconsciousness. ✓

Unconsciousness is believed to indicate the severity of the injury in direct ratio to its time that is, a long period of unconsciousness a very severe injury and vice versa. The following facts question this general belief. ✓ One patient (automobile collision) walked into the emergency station, became unconscious several hours later, and died the next day from a severe contusion and laceration of the brain. Another patient, after a very mild injury became unconscious on the third day from a large extradural hematoma. There were 8 major cases recorded as not having been unconscious, and these indicate that the state of consciousness upon the first examination ✓

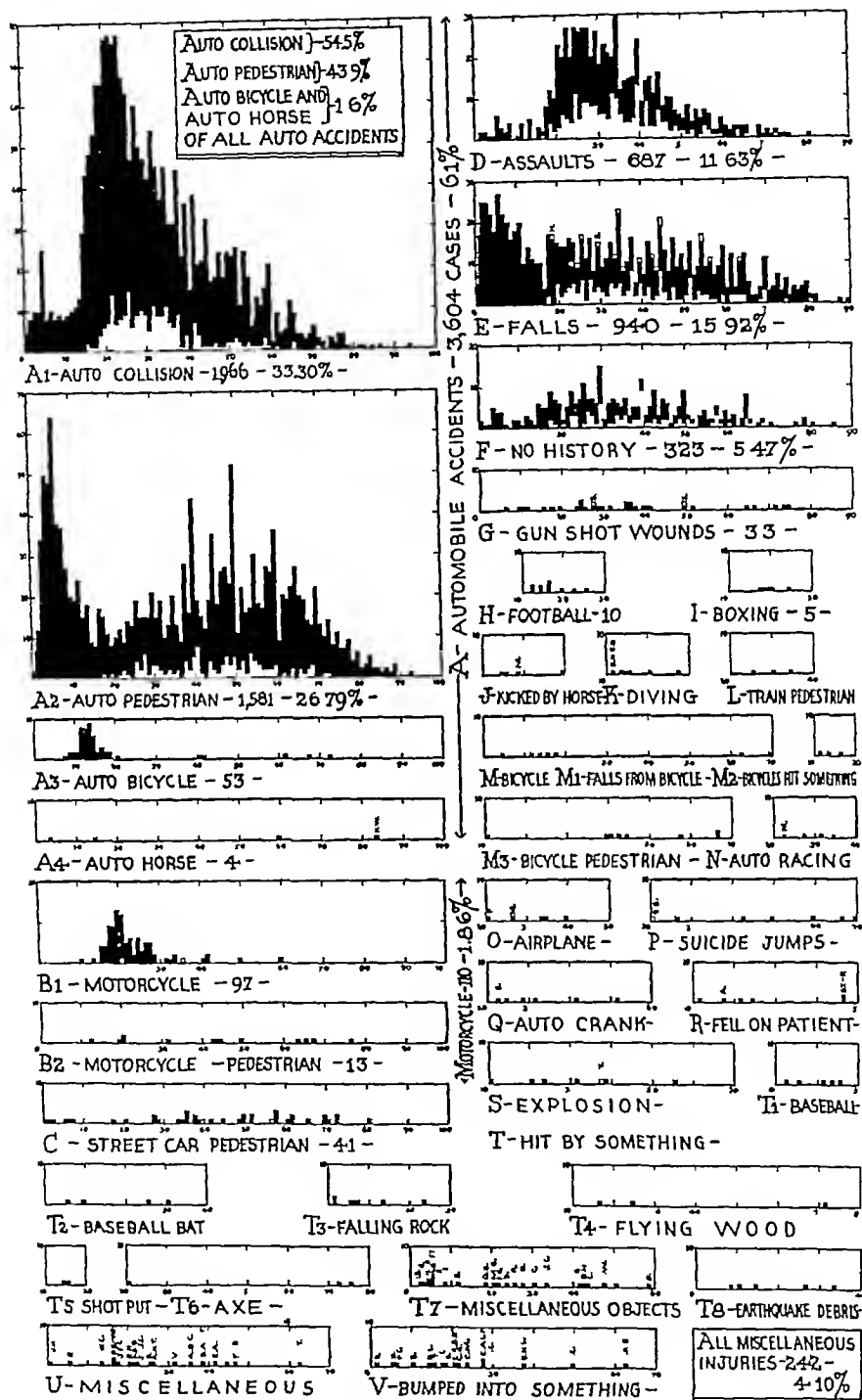


Fig 2 Age against manner of injury

is not a good criterion of the extent of injury. Short periods of unconsciousness or no unconsciousness do not warrant relaxation of vigilance.

**Objective evidence.** Some form of external abrasion, laceration, or contusion was present in 5,415 or 91.6 per cent, there being 497 or 8.4 per cent without external signs. Of the major cases 147 or 7.4 per cent, showed no external evidence of injury while among the minors 350, or 8.9 per cent, were without objective signs.

Although the absence of objective evidence of injury is very low nevertheless it must be taken into consideration that 7.4 per cent of the seriously hurt head injury patients will show no external evidence of injury. When confronted with an unconscious patient with no history possibly a person who has been drinking this is important. At least one such patient in this series died, a head injury not having been suspected as it was completely masked by no external evidence and superimposed alcoholism. There are, perhaps, more such cases than we realize ( ).

When ecchymosis of the eyelids is present, especially without local injury at that point, there is always a question of basal skull fracture. This is also true with blood from the nose, blood from the ear, blood from the mouth, and spinal fluid from ear, nose, or mouth, and ecchymosis of the mastoid regions. Spinal fluid from ear and nose was the only external evidence confined to the major cases. All of the other significant external evidences were present in minor as well as major cases, but the percentages in the major cases were greater. As examples, blood from ear, majors, 30.6 per cent, minor 5 per cent; blood from nose, majors, 18.3 per cent, minors, 7.5 per cent; ecchymosis of eyes, majors, 31.5 per cent, minors, 17.5 per cent.

**Subjective evidence.** Patients with subjective evidence totaled 1,663 or 28.1 per cent. The percentage of recorded subjective evidence in both major 568 cases or 28.7 per cent, and minor cases, 1,094 or 27.8 per cent, was approximately the same, indicating that subjective evidence must be very carefully evaluated before it is given consideration in estimating the degree of injury.

**Röntgen-ray examination.** Röntgen-ray examination was made on 5,336 patients, or 86.9 per cent. In 14. per cent of the major cases and 12.6 per cent of the minor cases no such examination was made. Death prevented such examination in 208 of the major cases. In 46 cases no reason was given, the conclusion being that these patients were not co-operative. 18 were transferred to other hospitals. 2 were demented. 4 had a ques-

tion mark on the record. The 476 minor cases not subjected to x-ray examination, and 21 without reports, were undoubtedly patients whose condition was satisfactory and recovery rapid.

**Skull fracture.** There were 1,362 proved skull fractures in 1,069 major cases, a 69.2 per cent proved skull fracture incidence in severely injured patients. Of these 1,362 cases, 1,071 were proved by x-ray and 29 confirmed at postmortem examination or at operation. There were 289 major cases in which there was no skull fracture upon roentgen-ray examination, and skull fracture was not diagnosed by clinical evidence. In addition to this there were 314 cases in which basal skull fracture was diagnosed but not proved. Proved at autopsy proved by x-ray not proved but diagnosed clinically gave a total skull abnormality in 1,680, or 28.5 per cent of the total and 85.2 per cent of the majors. No skull abnormality was present in 4,232 or 71.1 per cent, of the total, and in 289, or 14.7 per cent of the majors.

Considerable separation in the continuity of the skull can take place with injury which may resolve itself so completely that it cannot be demonstrated by roentgen-ray. This is illustrated by 0 cases of vault fracture and 23 cases of base and vault fracture which were not seen in the roentgenograms but were proved at autopsy. A basal skull fracture without x-ray evidence is not unusual. There were 9 other cases upon which roentgenograms were taken and skull fractures not seen, in which basal skull fracture was proved at postmortem examination. *These facts show that a negative skull set of films does not exclude fracture.*

Skull fracture of itself is not a cause of death (3.5, 0.32). It is the hemorrhage, contusion, and concussion accompanying the trauma which has caused the skull fracture and the consequent reactions to this injury that are responsible for death. This is dependent upon the mechanism of injury (5). As an example, one of the patients in this series was brought to the hospital with a very severe basal and vault fracture after having a piano fall upon his head. The patient made an uneventful recovery and the case was analogous to the cracking of an eggshell without injury to the contents. The 546 patients with skull fracture only and recovering without special treatment were cases which illustrate such conditions. If skull fracture is present the probability is that the brain injury is more severe. However this is by no means a rule.

**Eye abnormalities.** There were 52 patients with eye abnormalities, or 8.66 per cent. Of these 36 or 28.35 per cent, were major cases and 15

or 3 83 per cent, were minor cases. Inequality of the pupil was the most frequent finding. In diagnosis of massive hemorrhage a dilated pupil is of great value. However, its absence does not rule out massive hemorrhage (2, 9, 10, 15, 32). Pressure discs with acute head injuries are seldom found. The absence of pressure discs does not exclude massive hemorrhage. There was one case in this series with unilateral blindness which was relieved by release of pressure by spinal puncture. Incidences of nystagmus, deviation, ptosis, fixation, were few.

All eye signs are of the greatest importance and occasionally are very difficult to explain, as they may be evidences of destruction or irritation of nervous tissue, or pressure. It should be remembered that more than one explanation of an abnormal eye finding can be given, and that to estimate the localization and character of a lesion all of the possible explanations must be considered.

**Reflexes.** Patients with abnormalities numbered 513, or 8 67 per cent. Of these 367, or 18 65 per cent, were major cases, and 146, or 3 7 per cent were minor cases. Reflex findings depend upon the time after the injury at which the examination is made. During the period of shock the severity of the brain injury is difficult to diagnose. Often there is a physiological ablation of cortical influence, and there may be a complete absence of reflexes or no change whatever. As shock passes away and the brain adjusts itself to the injury, reflexes return and paralyses manifest themselves and may run the course of spasticity to flaccidity, or vice versa.

In several cases notes by one observer showed reflex changes and by another showed a discrepancy in the findings. Reflexes alter as the pathological condition progresses or regresses, and these discrepancies were due to this. The various reflex findings may be present in both major and minor cases, but in cases of severe injury the percentage is much higher. Reflex changes and eye changes run about the same percentage and are approximately paralleled by the number of pathological plantar responses. Incidences of spasticity, paralysis, clonus, convulsions, were small in comparison. Stiff neck was present in 360 cases, and 245 of these were from the major case group. Excluding the meningitis cases, these were presumed to be due to subarachnoid bleeding.

There were 24 cases of peripheral facial palsy, an incidence of 0 4 per cent of the total, 5,912, 1 2 per cent of the majors, 1,969. The time of onset was from 1 to 7 days after the injury. The later onsets were probably due to edema of the facial nerve, the earlier ones to basal skull

fracture with injury to the nerve. Complete follow-up records on these cases were not present. However, all were recorded upon subsequent entries as recovered. Some of the recoveries took place before discharge. One patient with peripheral palsy died of meningitis.

**Pulse.** A careful watch of the pulse rate is one of the most important procedures in the care of cerebral injury. Many slow pulses would be caught in a 15 minute pulse charting that are overlooked in a 4-hour charting. Slow pulse rates indicate attempt at compensation to pressure from edema, or massive hemorrhage. The pulse of shock is rapid and weak, the pulse of edema is slow and full, the pulse of medullary compression or decompensation variable, changing from fast, weak, and irregular to slow, strong, and regular. These changes may occur within a few minutes.

With compensation taking place the majority of patients ran a slow pulse for their age. The relation between age and pulse rate must be considered with children especially, as a comparatively slow pulse for infancy might be a rapid one for maturity. With general decompensation to pressure or the complications of infection a rise in the pulse rate took place. In one case, during fluid restriction regimen, the rapid pulse rate of toxic dehydration simulated the rapid pulse rate of pressure decompensation. One other form of slow pulse rate that should not be confused with edema is that caused by sedatives.

**Respiration.** Respiration is rapid during shock and slow during periods of edema. It varies in direct relation to the pulse rate, and for the same reasons. In this series Cheyne-Stokes respiration was found in others as well as in terminal cases. It is usually considered as a sign of medullary compression and is a warning of cerebral decompensation. However, it may be present with dehydration. The effects of sedatives can give an alarming picture, with Cheyne-Stokes respiration and a slow pulse. A careful watch of the respiration is concomitant and ranks equally in importance with the careful watch of the pulse.

**Blood pressure.** Just as the pulse was usually slow for the age with a compensating brain, the blood pressure was usually slightly elevated. There were many cases in which a slow pulse indicated edema, in which the blood pressure seemed normal, and there were other cases with a rapid pulse due to dehydration with no apparent alteration in the blood pressure. The diastolic pressure in some cases was very low. During decompensation the blood pressure rises until the break preceding death. In the majority of cases the constancy of the blood pressure was remarkable.



**Temperature.** There was a mild rise in temperature in almost every case after the subnormal temperature of shock had ceased. In children the rise was marked. In fatal cases the temperature rose with decompensation, and the patients approached death with hyperthermia, in some cases the temperature ranging as high as 108 degrees. As a patient recovered the slightly raised temperature returned to normal. However it also returned to normal in some cases which did not recover but in which the compensation for the time being was excellent. In one case a pressure temperature due to subdural hematoma was mistaken for that of bronchopneumonia, and it is obvious that this temperature rise was an early decompensation indication with hypostatic pneumonia developing. Temperature may be altered upward by intensive dehydration by transfusion reactions by injury to the temperature regulating centers and, secondarily by pressure.

It is quite natural to regard definite objective evidences such as external injuries, roentgen-ray findings, state of consciousness, as the most important factors in diagnosis. The external manifestations of physiological changes within indicate what is happening to a brain which we cannot examine. Therefore changes in the reflexes, temperature, pulse, respiration, and blood pressure are our most important aids (4, 35).

#### TREATMENT

In the treatment of acute head injuries several definite principles are recognized: absolute and prolonged rest, control of intracranial pressure, maintenance of tissue nourishment, both general and local. These purposes are accomplished by sedatives, non-interference dehydration, lumbar puncture, intravenous hypertonic solutions, tube feedings, surgery. Each case is a law unto itself and may need one or all of these procedures (6, 13, 16, 17, 23, 26, 28, 29).

**Medication.** Intravenous glucose, 50 per cent, was the most common form of medication. It was administered in a total of 858 cases, or 14.5 per cent. It was used in 581, or 29.5 per cent, of the major cases. Hypertonic injections, intravenously have been used for some years and their use has been defended by physiological research and by successes in treatment in various localities (3, 6, 7, 11, 13, 16, 17, 23, 26, 28, 29, 33). Faith in this method of reducing increased intracranial pressure is at present waning.

Thirty-three patients showed sugar in the urine. The question arose whether or not this was due to the administration of glucose or to an upset in the sugar metabolism due to a blow on the head.

A generalized concussion can cause a change in the sugar metabolism and a discharge of sugar into the urine.

Glucose in normal saline solution, intravenously was used infrequently. Restriction of fluids was used in a very small number of cases. There were 113 patients who received normal salt intravenously. The administration of fluids in head injury cases is a matter of controversy (8, 11), and there is a difference of opinion among authorities.

Many patients received morphine at the emergency station. With the logical arguments against it and the general feeling of neurosurgeons that morphine is dangerous, it should not be used (1). Urotropine was administered intravenously for suspected meningitis. One patient with meningitis recovered and the recovery was attributed to this treatment. Sulfanilamide and its associated compounds, is now used. Various other forms of medication were used for sedation, stimulation, and dehydration, and the percentages were small. The treatment in this series was of a conservative nature and depended in a great part upon non-interference and rest. These should be the basic requirements (6).

**Spinal puncture.** Spinal puncture embraces both treatment and diagnosis. A total of 831 patients received this treatment, 14.1 per cent. 613 of these or 31.1 per cent were major and 221 or 5.6 per cent were minor cases. There were cases of recovery and of death with almost every combination of pressure and appearance. For instance normal pressure normal appearance, 167 cases, with a major death rate of 13.2 per cent normal pressure, bloody 117 cases, death rate 31.7 per cent low pressure bloody 19 cases, death rate 46.7 per cent high pressure, yellow 29 cases, death rate 33 per cent. Of the cases with spinal fluid of high pressure, normal appearance the majority were in the minor group, there being only 3 deaths in the major group. With a pressure above 300 millimeters and normal appearance the majority of cases fell into the major group and the death rate was greatly increased. Among those with high pressure and changed appearance the death rate was high. However there was one case with a pressure of 500 millimeters and bloody fluid and the patient recovered.

Many patients receiving spinal punctures died. This does not mean that spinal punctures are contra indicated but merely that spinal puncture is more likely to be done upon a patient whose condition is serious and who may die. Spinal drainage for treatment was carried out with success in several cases. It is a very effective method

of reducing increased intracranial pressure where there is no block in the ventricular system (18-22, 34)

Three incidents were recorded to which special attention is called that of the blood pressure falling after spinal puncture that of the regaining of consciousness after spinal puncture, and that of the pressure being high and falling after administration of intravenous glucose. These are all of importance. They show the pressure reduction after spinal puncture, and the third, especially, shows that a spinal fluid reading shortly after the injection of intravenous glucose is of little value in estimating the pressure in the brain.

Treatment with spinal puncture, hypertonic solution, and restriction of fluids may be greatly overdone (20-22). Hypertonic dextrose solution routinely administered without depletion of general bodily fluids causes increased edema and may cause death. Under a fluid restriction regimen, a patient can die from toxic dehydration, and in the use of any of these procedures for the reduction of increased intracranial pressure very careful watch of the reactions must be provided in order to avert the complications of the treatment as well as to judge its efficacy.

**Operations** A total of 195 was carried out, 3.3 per cent, of 5912, 9.9 per cent of major cases, 1,969.

The value of operative interference in head injury recovery has often been questioned. It has as its purpose 2 things: the removal of massive hemorrhage, and the reduction of pressure by drainage of fluid (9, 15, 25, 31). In keeping with the general conservative management of this type of case the number of operations in this series was small. Elevations of depressed fragments, 103, comprised 52.8 per cent of the operations, with an 8.7 per cent death rate, subtemporal decompressions, 50 cases or 25.6 per cent, with a death rate of 36 per cent, extradural hematoma, 9 cases, or 4.6 per cent, with a death rate of 77.8 per cent, subdural hematomas, 18 cases, or 9.2 per cent, with a death rate of 22.2 per cent. In 15 cases, or 13 per cent of the operations, there was found massive fluid collection which was not diagnosed before operation. Only one patient died, a death rate of 6.6 per cent. Simple trephining of the skull was not done in these cases, a complete decompression operation having been performed once the patient was in the operating room. The use of subtemporal decompression has greatly decreased, trephining taking its place. The size of the area to be exposed in decompression is exceedingly small compared to the size of the area of the entire brain, and when the opera-

tion is successful it is because of the release of fluid from the subdural and subarachnoid spaces, and this can be accomplished through a trephine opening (9, 15, 25, 31). In cases with increased intracranial pressure a trephine opening, with release of subdural fluid, or decompression by means of ventricular drainage is a less hazardous procedure than even spinal puncture.

In one of the cases of extradural hematoma the clinical picture was classical, and bilateral subtemporal decompression, performed in a routine manner, failed to disclose the hematoma. At autopsy the large extradural hematoma which had been diagnosed was found 1 centimeter anterior to the site of operation. Exploration with multiple trephines would have located this hematoma (15).

#### COMPLICATIONS

The incidence of complications was taken from the postmortem records and percentages were figured only against each condition, as there was often more than one of these conditions in a single case.

**Edema** It is assumed that a certain degree of edema takes place in every case and it is the factor in head injury work to which the treatment is most often directed. At autopsy, however, only 53 cases, or 2.6 per cent of the majors and 0.9 per cent of the total, showed this complication alone. No cases with other complications were without it.

**Diffuse hemorrhage, contusion, laceration** The highest other complication was diffuse subdural hemorrhage, 213 cases, or 3.6 per cent of the total, 10.8 per cent of the major cases. Next highest was contusion, 103 cases, or 1.7 per cent of total, 5.2 per cent of the major cases. Contusions and lacerations of the brain, and subarachnoid hemorrhage were diagnosed in a number of patients who recovered and there was no proof that such complications were present. There were 9 patients with a history of old head injuries and 6 of these died, the presence of the previous injury being found at postmortem examination. There are also records of contusions shown at autopsy in patients who died of other causes. Thus the figures for most of these complications may be small compared to the number of these conditions that actually do exist and are not known accurately because of the recovery of the patient. Contusions and lacerations, if not in vital areas, need not cause the death of the patient, as we know that large portions of the brain may be destroyed without death.

Petechial hemorrhages, a very important complication, have unfortunately been omitted in the

numerical summary. They are frequent about contusions and lacerations, and in localized areas (5). Two reasons for their presence are possible: original injury and capillary blocking in an area of most intense edema. The latter hypothesis is favored by me and is logically supported by the reactions which take place in injury.

**Massive hemorrhage and fluid collections.** There were 46 cases of massive subdural hemorrhage or 75 per cent of the total, 23 per cent of the major cases. Fourteen of these recovered after surgery, thus leaving 32 deaths in which the result was due to the severity of the original injury or in which the clinical evidence was not sufficient to warrant surgery. There were at least 50 patients who had been in the hospital more than 5 days—one of them as long as 60 days—in which there was shown at postmortem examination massive subdural hemorrhage. This fact makes it logical to suppose that had the space-occupying hemorrhage been discovered and released these patients might have recovered.

There were 38 patients or 64 per cent of the total, 1.9 per cent of the major cases, with massive extradural hemorrhage with 36 deaths. Of the patients who died 4 were in the hospital over 5 days, the longest stay being 9 days. The same conclusions were arrived at regarding massive extradural as massive subdural hemorrhage. Both extradural and subdural hematomas are of a rapid nature as regards mortality. They were often present in this series without the so called classic signs (10, 32).

Subdural fluid collections numbered 23, or 39 per cent of the total, 1.2 per cent of the major cases. Eight were found at autopsy, 15 at surgery.

**Infection.** The incidence of otitis media was 19 cases, or 32 per cent of the total, 0.95 per cent of the major cases. Among the otitis media cases there were 2 deaths from meningitis, one on the eighth and 1 on the forty third day. Five of these cases, including one of the deaths, were further complicated by mastoiditis. Otitis media as a complication of head injury was much more frequent in children, there being 12 patients under the age of 13. Seven other patients were adults, the oldest being 46 the youngest 17.

There were 33 meningitis cases, or 55 per cent of the total, 1.6 per cent of the major cases. One patient recovered. Five died on the first hospital day. These deaths were mostly in young patients, aged 35, 7, 14, 19, and only 1 occurred in an adult, 50. Two died upon the third day, 2 upon the fourth, 4 upon the fifth, 2 upon the sixth, 1 upon the seventh, 4 upon the eighth day, 1 each of 11 patients on later days up to the forty

seventh, and 1 on the two-hundred-and-fortieth day. The onsets of meningitis were equally varied. The danger from meningitis is felt to be present after basal skull fracture for the time of 6 months, but it usually appears within 60 days.

One patient with a lung abscess developed a subdural abscess and it is felt that the head injury effected this complication of the lung abscess. There were 2 other cases of subdural abscess and 2 cases of brain abscess.

Thirty-six cases were complicated by pneumonia, and in the majority of these it was recorded as hypostatic. 1 was lobar and 9 were recorded as bronchopneumonia.

Six of the patients who remained in the hospital for a long time developed bed sores. Five of these died.

**Miscellaneous.** Any debilitating disease, such as tuberculosis or diabetes was noted 1 case, what ordinarily would have been a minor case to become a major one. Three patients who had tuberculosis died of minor head injuries. Others who died had angina pectoris, kidney disease, diabetes.

There were 100 cases in which the age of the patient was considered a factor in the death, and among these aged patients it was somewhat surprising to discover that 15 had massive subdural hemorrhage. This was an important finding as an aged patient is often thought to be apoplectic, even though the history of injury is definite, and because of this he is seldom considered a proper subject for surgical treatment. Notes have been made that several of these aged patients might possibly have been saved by discovery and removal of the massive hemorrhage. Advanced age and head injury regardless how minor is a combination which always throws a case into the major group.

There were 2 patients with internal hydrocephalus resulting from the injury who died after a long period in the hospital. There were also 2 with perimeningitis, 1 of whom died of meningitis. There were 3 cases that were probably complicated by the length of the emergency repair anesthetic. Anesthesia in itself increases edema of the brain, and with a brain that is at least potentially edematous it may assist in a reaction that will be fatal.

There were 9 cases of pre-injury psychosis, and this was partially responsible for the injury. There were 11 cases of pre-injury epilepsy and in these the epilepsy was a factor in the injury. Four of these patients died because of the head injury and a majority had epilepsy due to a previous head injury.

## RESULTS

Of the total number of cases there was a 92.5 per cent recovery and a 7.5 per cent death rate, of the majors a 77.4 per cent recovery and a 22.6 per cent death rate. Of the recoveries, and from the major cases, there were 71 known post-traumatic mental disturbances (27, 30), and 2 known posttraumatic epilepsies. Many of these patients were originally discharged from the hospital as minor cases with recovery, but have been classified here among the major cases because of the sequelæ.

The follow-ups in this series are not good and these results are merely stated as being known, but may actually be very much higher in disability.

## CONCLUSIONS

It is easy after a death has occurred and the pathological condition has been examined to say that had we been alert this life or that might possibly have been saved. However, it is difficult before death to make the decision and in many cases it can only be made upon probability. The largest number of patients died upon the first day and these undoubtedly were cases to which the classification of hopeless might be applied, that is, no matter what was done the outcome would be fatal. As has been mentioned earlier the danger lies in assuming that patients either recover or do not recover, and the throwing of 24 per cent of the total—the problem cases—into the hopeless class. Proper emergency and subsequent treatment will save more of these seriously injured patients.

✓ A careful watch of the external manifestations of the physiological reactions within are the most important factors in the care of the patient. Other than absolute quiet there are no routine indications in treatment, and the tax upon the judgment of the attending surgeon is unceasing until recovery. ✓

It has been implied that perhaps the greatest fault in emergency treatment is the movement of the patient and his transference from one hospital to another during the acute stage (6). It is felt that this movement entails enough stimulation to increase shock if shock is present, to increase bleeding if shock is not present, to increase to its maximum any reaction that may be taking place. Three patients who were apparently not seriously injured and who upon first examination at the emergency station were conscious and rational, later developed severe intracranial conditions after they disregarded the rule that absolute quiet was necessary. This emphasizes the

probability of increase in complications due to movement of those who are obviously injured.

## SUMMARY

1 A gross summation has been taken from a tabular statistical survey of 5,912 head injury case records.

2 Important incidences in etiology, treatment, and complications are enumerated and discussed.

3 The trend of present day treatment has been indicated by comment.

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numerical summary. They are frequent about contusions and lacerations, and in localized areas (5). Two reasons for their presence are possible: original injury and capillary blocking in an area of most intense edema. The latter hypothesis is favored by me and is logically supported by the reactions which take place in injury.

**Massive hemorrhage and fluid collections.** There were 46 cases of massive subdural hemorrhage or 75 per cent of the total, 23 per cent of the major cases. Fourteen of these recovered after surgery, thus leaving 32 deaths in which the result was due to the severity of the original injury or in which the clinical evidence was not sufficient to warrant surgery. There were at least 10 patients who had been in the hospital more than 5 days—one of them as long as 60 days—in which there was shown at postmortem examination massive subdural hemorrhage. This fact makes it logical to suppose that had the space-occupying hemorrhage been discovered and released these patients might have recovered.

There were 38 patients, or 64 per cent of the total, 19 per cent of the major cases, with massive extradural hemorrhage, with 36 deaths. Of the patients who died 4 were in the hospital over 5 days, the longest stay being 9 days. The same conclusions were arrived at regarding massive extradural as massive subdural hemorrhage. Both extradural and subdural hematoma are of a rapid nature as regards mortality. They were often present in this series without the so called classic signs (2, 10, 32).

Subdural fluid collections numbered 23 or 39 per cent of the total, 12 per cent of the major cases. Eight were found at autopsy, 5 at surgery.

**Infection.** The incidence of otitis media was 19 cases, or 32 per cent of the total, 0.95 per cent of the major cases. Among the otitis media cases there were 2 deaths from meningitis, one on the eighth and 1 on the forty-third day. Five of these cases, including one of the deaths, were further complicated by mastoiditis. Otitis media as a complication of head injury was much more frequent in children than being patients under the age of 13. Seven other patients were adults, the oldest being 46, the youngest 17.

There were 33 meningitis cases, or 55 per cent of the total, 1.6 per cent of the major cases. One patient recovered. Five died on the first hospital day. These deaths were mostly in young patients, aged 1½, 7, 14, 19, and only 1 occurred in an adult, 50. Two died upon the third day, 2 upon the fourth, 4 upon the fifth, 3 upon the sixth, 1 upon the seventh, 4 upon the eighth day, 1 each of 11 patients on later days up to the forty

seventh, and 1 on the two-hundred-and-fortieth day. The onsets of meningitis were equally varied. The danger from meningitis is felt to be present after basal skull fracture for the time of 6 months, but it usually appears within 60 days.

One patient with a lung abscess developed a subdural abscess and it is felt that the head injury effected this complication of the lung abscess. There were 2 other cases of subdural abscess and 2 cases of brain abscess.

Thirty-six cases were complicated by pneumonia, and in the majority of these it was recorded as hypostatic: 1 was lobar and 9 were recorded as bronchopneumonia.

Six of the patients who remained in the hospital for a long time developed bed sores. Five of these died.

**Miscellaneous.** Any debilitating disease such as tuberculosis or diabetes was noted to cause what ordinarily would have been a minor case to become a major one. Three patients who had tuberculosis died of minor head injuries. Others who died had angina pectoris, kidney disease, diabetes.

There were 109 cases in which the age of the patient was considered a factor in the death and among these aged patients it was somewhat surprising to discover that 13 had massive subdural hemorrhage. This was an important finding as an aged patient is often thought to be apoplectic, even though the history of injury is definite, and because of this he is seldom considered a proper subject for surgical treatment. Notes have been made that several of these aged patients might possibly have been saved by discovery and removal of the massive hemorrhage. Advanced age and head injury regardless how minor is a combination which always throws a case into the major group.

There were patients with internal hydrocephalus resulting from the injury who died after a long period in the hospital. There were also 2 with pneumoventricle, 1 of whom died of meningitis. There were 3 cases that were probably complicated by the length of the emergency repair anesthetic. Anesthesia in itself increases edema of the brain, and with a brain that is at least potentially edematous it may assist in a reaction that will be fatal.

There were 9 cases of pre-injury psychosis, and this was partially responsible for the injury. There were 11 cases of pre-injury epilepsy and in these the epilepsy was a factor in the injury. Four of these patients died because of the head injury and a majority had epilepsy due to a previous head injury.

## RESULTS

Of the total number of cases there was a 92.5 per cent recovery and a 7.5 per cent death rate, of the majors a 77.4 per cent recovery and a 22.6 per cent death rate. Of the recoveries, and from the major cases, there were 71 known post-traumatic mental disturbances (27, 30), and 2 known posttraumatic epilepsies. Many of these patients were originally discharged from the hospital as minor cases with recovery, but have been classified here among the major cases because of the sequelae.

The follow-ups in this series are not good and these results are merely stated as being known, but may actually be very much higher in disability.

## CONCLUSIONS

It is easy after a death has occurred and the pathological condition has been examined to say that had we been alert this life or that might possibly have been saved. However, it is difficult before death to make the decision and in many cases it can only be made upon probability. The largest number of patients died upon the first day and these undoubtedly were cases to which the classification of hopeless might be applied, that is, no matter what was done the outcome would be fatal. As has been mentioned earlier the danger lies in assuming that patients either recover or do not recover, and the throwing of 24 per cent of the total—the problem cases—into the hopeless class. Proper emergency and subsequent treatment will save more of these seriously injured patients.

✓ A careful watch of the external manifestations of the physiological reactions within are the most important factors in the care of the patient. Other than absolute quiet there are no routine indications in treatment, and the tax upon the judgment of the attending surgeon is unceasing until recovery. ✓

It has been implied that perhaps the greatest fault in emergency treatment is the movement of the patient and his transference from one hospital to another during the acute stage (6). It is felt that this movement entails enough stimulation to increase shock if shock is present, to increase bleeding if shock is not present, to increase to its maximum any reaction that may be taking place. Three patients who were apparently not seriously injured and who upon first examination at the emergency station were conscious and rational, later developed severe intracranial conditions after they disregarded the rule that absolute quiet was necessary. This emphasizes the

probability of increase in complications due to movement of those who are obviously injured.

## SUMMARY

1 A gross summation has been taken from a tabular statistical survey of 5,912 head injury case records.

2 Important incidences in etiology, treatment, and complications are enumerated and discussed.

3 The trend of present day treatment has been indicated by comment.

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Fig. 3

Fig. 3 Case F. W. Lateral view of left elbow showing supracondylar fracture 5 days after injury. Little poor reduction.



Fig. 4

Fig. 4 Case F. W. Same elbow 4 years later showing bony block preventing complete extension.



Fig. 5

Fig. 5 Case F. W. Same elbow 20 years later showing normal elbow.

*Good*—no serious alteration in structure or function but obviously not normal even when viewed alone.

*Fair*—definite defect in structure and function but no serious disability.

*Poor*—serious disability due to poor function and structure.

When the end results of the supracondylar fractures were evaluated, we found with one exception that they were all good to normal. This patient had a compound fracture which had been treated by an outside physician by a closed reduction and the child had been referred to the Children's Hospital 5 days later with the arm immobilized in a plaster splint. X-ray examination

revealed that the fracture was incompletely reduced, the lower fragment being still posterior and slightly lateral, and the upper fragment rotated. Because this was a compound fracture it was felt unsafe to manipulate it further and fixation in the posterior position was continued for 4 weeks, following which the splint was removed and physiotherapy was started. Two years after the initial injury there was a permanent flexion deformity of 20 degrees. This degree of deformity was also present at the follow-up examination 4 years after the injury. This deformity in no way interfered with function of the elbow and caused no disability. X-ray examination taken 4 years after the initial injury showed the lower portion



Fig. 6

Fig. 6 Case J. K. Complete supracondylar fracture of the left elbow. a, anteroposterior and b, lateral view.



Fig. 7

Fig. 7 Case J. K. Postreduction roentgenogram made



Fig. 8

Fig. 8 Case J. K. Follow-up roentgenogram 20 years after injury showing normal elbow.



Fig. 9

Fig. 9 Case J. K. Follow-up roentgenogram 20 years after injury showing normal elbow.



Fig 6 Case 3, R B End result of supracondylar fracture 2 years previously showing marked cubitus varus deformity with reduction of carrying angle secondary to growth changes in the epiphysis of the lower end of the humerus

of the humerus to be still posterior, probably producing a bone block and preventing complete extension of the elbow. The roentgenograms of this patient's elbow are shown in Figures 1 and 2.

There were 6 fractures in this series in which the postreduction films were considered unsatis-



Fig 7 Case 3 Roentgenogram showing overgrowth of external epicondyle following supracondylar fracture

factory. All of these went on to normal or excellent end-results with the exception of the one case already noted. The roentgenograms of one of these cases are shown to illustrate the restoration of normal relationships in spite of a poor reduction. This boy of 7 sustained a left supracondylar fracture which was treated by a closed reduction at the Children's Hospital. Immediate postreduction x-ray films were considered satisfactory, but check-up examination 12 days later showed



Fig 8

Fig 8 Case 4 G M Fracture of left external epicondyle and capitellum with typical posterior and lateral displacement of the distal fragment—one of the most treacherous



Fig 9

fractures of elbow in children. Open reduction would have been the best treatment. Closed reduction

Fig 9 Case 4 End-result 8 years later. Non union



Fig.

Fig. 10. Case 5. 1 1/2. Fractured external epicondyle and capitellum with typical displacement.



Fig.

Fig. 11. Case 5. Thirteen years after open reduction child now has normal elbow.

the distal fragment again to have slipped posteriorly. No attempt was made to correct this second displacement, and on examination 10 years later the x ray revealed normal bone structures.

In spite of the excellent functional results obtained in these supracondylar fractures, very careful measurements of the carrying angles of both the normal and the injured elbows revealed definite alteration in the angles of the injured as compared to the normal elbow, even though many years had elapsed since the original injury. These measurements were all made with the goniometer and the same technique was employed in measuring each elbow. In 8 cases there was a definite diminution in the carrying angle, ranging from 5 to 15 degrees—sufficient to produce a definite cubitus varus. In case there was an increase in the carrying angle of 5 degrees.

In attempting to determine why this alteration of carrying angles should result, we examined carefully the postreduction roentgenograms of those cases which had the greatest amount of cubitus varus, to see if the fragments were locked with slight medial displacement which would be sufficient to obliterate the carrying angle. We could find nothing to substantiate this belief in fact many of the films showed quite the reverse. We present herewith the roentgenograms of the case which showed the greatest reduction in carrying angle. As will be noted in the postreduction roentgenograms, the fragments are locked in a position of definite radial deviation, or *algus*. Furthermore since we have seen fractures with definite posterior displacement return to normal

alignment several years after the original injury, we are convinced that minor lateral displacements will likewise return to normal over a period of years unless some other factor is operating. We believe this factor to be changes in growth of the lower humeral epiphysis as the result of the fracture and that these growth changes persist over a period of years. At the follow up examinations, measurements of the lengths of the humeri were made from the acromion process to the external epicondyle and from the coracoid process to the internal epicondyle of both extremities. These bony points are easily defined in children and young adults who are not too fleshy and measurements can be made with a fair degree of accuracy. We consider  $\frac{1}{8}$  of an inch to be the limit of measurable error and measurements that did not exceed  $\frac{1}{8}$  of an inch were discounted. When these measurements were tabulated, it was found that the external measurements of the affected elbow exceeded the internal measurement of the elbow by  $\frac{1}{8}$  to  $\frac{3}{8}$  of an inch in 6 of the 8 cases that showed a cubitus varus. In the case that showed an increase in carrying angle the external measurement was less than the internal. From this observation we may deduce that the epiphysis of the external epicondyle was stimulated as the result of the fracture and that this stimulus persisted over a period of years. As the result of the increased growth of the epiphysis of the external epicondyle the carrying angle at the elbow gradually diminished so that the end-result was a varying degree of cubitus varus. The most marked diminution in carrying angle occurred in cases of



Fig 12

Fig 13

Fig 12 Case 6, F N Slight separation of epiphysis of right internal epicondyle This type of injury was considered to be very trivial in the past, but in our series it invariably results in non union without impairing function of the elbow

Fig 13 Case 6 Seven years after closed reduction showing non union

complete fracture with displacement, but in 2 cases of incomplete fracture without displacement, diminution of the carrying angle of 5 degrees or less was noted This would seem to confirm the observation that it is not the initial displacement which alters the carrying angle, but subsequent growth changes

Growth stimulation of an epiphysis following fracture is not a new concept and has been reported for both the femur and the radius by Attkin

#### FRACTURES OF THE EXTERNAL EPICONDYLE AND CAPITELLUM

There were 28 fractures of the external epicondyle and capitellum in this series, of which 10 returned for follow-up Three of these fractures were recent and seen the day of injury, the others were old fractures and seen at intervals varying from 2 weeks to many months The end-results in this group of fractures were not nearly as satisfactory as in the supracondylar fractures Four of the 10 were poor and the remainder good to normal The poor results were due to non-union or malunion Any fracture in which 40 per cent of the cases end in poor results should be considered as a serious lesion Of particular interest also is the fact that 17 of 28 of these cases came to us many weeks or months after the original injury, all with displaced fragments, apparently most of which were not united The conventional method of treating this fracture had failed to produce a satisfactory result It is, therefore, important

that we analyze the good results in our future handling of these cases

Three of these fractures showed no displacement The end-result in all of these cases was good One of the remaining 7 had an open reduction at another institution, and bone union resulted after a long period of disability Another treated by open reduction at this hospital likewise went on to bone union and an excellent end-result The third treated by closed reduction at this hospital likewise went on to a good end-result When the poor results were analyzed, it was noted that 3 of the patients treated by closed reduction resulted in non-union The fourth patient was treated by open reduction in this institution 2 months after the original injury Post-operative sepsis ensued, the fragment sequestered and had to be removed This is the poorest result in the entire series Thus there were 3 open reductions with a  $33\frac{1}{3}$  per cent poor result and 4 closed reductions with 75 per cent poor results It is evident that in fractures of the external epicondyle and capitellum with much displacement, open reduction is probably the method of choice, This does not preclude the possibility of a good result being obtained by closed methods if the fragment can be accurately replaced and maintained until bone union results

In examining these children many years after the original injury, changes in the carrying angle were observed In the 3 cases without displacement, 2 showed a diminution in carrying angle similar to supracondylar fractures, indicating, we



Fig. 4.

Fig. 4. Case 7 J. S. Moderate separation of the epiphysis of the right internal epicondyle.



Fig. 5.

Fig. 5. Case 7. Three years after open suture—irregular in outline but apparently well united.

believe stimulation of the epiphysis of the external epicondyle. This is borne out by measurements which show an increase in length from the acromion to the external epicondyle. In all of the remaining cases an increase in carrying angle was shown, frequently resulting in a marked cubitus valgus due to a diminution in growth of the epiphyses of the external epicondyle. This was especially marked in those cases of non-union. Retardation of growth of the external epiphysis was shown by measurements from the acromion and coracoid to the external and internal epicondyles, respectively.

We believe that the seriousness of this type of elbow fracture is not generally appreciated. In spite of the poor anatomical results the function of the elbow was excellent in all cases except the one in which the sequestered fragment was removed. The return of function in this type of injury is exceedingly slow and it may be a year or more before full extension is obtained. This period is shortened considerably following open reduction if bone union results. Another factor not usually appreciated in the handling of these fractures is the harmful effects of the application of force to increase the range of motion. Forceful passive motions, "pump-handles" the carrying of heavy weights and irons, and other such procedures in common use lengthen the period of disability and are mentioned only to be con-

demned. The only physiotherapy indicated during the convalescent care of a fractured elbow is active exercise and active use of the extremity.

#### SEPARATIONS OF THE INTERNAL EPICONDYLAR EPIPHYSIS

There were 11 separations of the internal epicondylar epiphysis in this series, of which 7 returned for follow-up. The epiphysis for the internal epicondyle appears after the fifth year so these children range in age from 6 to  $\frac{1}{2}$ . All the follow-up examinations revealed non-union of the internal epicondylar epiphyses except one case. This case was the only one in the series in which patient had an open reduction with suture of the separated epiphysis. The other patients were treated conservatively. Even in the patient treated by open suture, the epiphysis is irregular in contour with some overgrowth of bone.

Follow-up examinations from 3½ to 7 years after the initial injury revealed no evidence of the occurrence of growth disturbances such as have described following both supracondylar and external epicondylar fractures. This is all the more surprising when one considers that here the

injury occurs at the epiphyseal plate whereas the other fracture lines are proximal to the epiphyseal plates. Careful measurements from acromion to external epicondyle and coracoid to internal epicondyle reveal normal growth even when the

epiphysis shows evidence of non-union and the carrying angles of both the injured and the normal elbows are the same. It would seem to be evident, then, that the alterations in carrying angles observed in supracondylar and external epicondylar fractures need not be expected to follow separations of the internal epicondylar epiphysis, even if non-union should occur.

We believe that if non-union of the separated internal epicondylar epiphysis is to be avoided in the presence of even minor degrees of separation, an open operation with suture of the displaced fragment is necessary. However, this follow-up study also shows conclusively that non-union of a separated internal epicondylar epiphysis in no way prejudices either the structure or the function of the elbow joint, and except for an undue prominence of the internal epicondyle, there are no other external evidences of non-union.

#### SUMMARY

1 This study confirms the prevailing opinion that the functional end-results in the treatment of

supracondylar fractures are uniformly good, even when the fractures are not necessarily accurately reduced.

2 A diminution in the carrying angle of the elbow producing a cubitus varus deformity is often a sequence following supracondylar fractures (28 per cent in this series), and may be caused by stimulation of the external epicondylar and capitellar epiphyses due to the fractures. This anatomical derangement usually does not affect the function of the elbow.

3 Fractures of the external epicondyle and capitellum in childhood are serious injuries, and if treated in the conventional manner, will result in a large percentage of cases in non-union and severe distortion of the elbow. In the presence of even minor displacement which cannot be completely corrected, open reduction is the method of treatment that offers the best end-result.

4 Separation of the epiphysis of the medial epicondyle has been considered a minor injury, but if non-union is to be avoided open suture is advised.

## MULTIPLE PRIMARY CARCINOMA

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LATELY considerable interest has been shown in multiple primary malignant tumors. Billroth is credited with being the first to report their occurrence, in 1869. Since then, many cases have been reported in the literature but not in any great numbers until recently. It was not because they did not formerly occur but they were very likely overlooked. Undoubtedly many primary lesions have been mistaken for metastases.

Goetze suggests the following criteria as essential in making a diagnosis of multiple primary carcinoma: (1) The tumor must have the macroscopic and microscopic appearance of usual tumors of the organs involved. (2) exclusion of metastasis must be certain.

The diagnosis may be confirmed by the character of the metastases. It is rather exceptional in multiple primary cancers, however, for more than one to metastasize. This undoubtedly is accounted for by the difference in the activity of the growths. For instance, grade 4 carcinomas would naturally metastasize more quickly than grade 1. Then again, when two cancers are found, one may have developed long before the other and, naturally, the one that developed first would be more likely to metastasize, especially if the two cancers were of the same grade.

Without offering substantial proof Broders suggests that the average grade of multiple primary malignant tumors should be higher than that of a like group of single malignant tumors.

In an article recently published by Kirschbaum and Shively a report was made of 1,413 autopsies performed at the Cook County Hospital in cancer cases. There were 25 cases of multiple carcinoma found in this group, an incidence of 77 per cent. Of these only 4 patients showed metastases from both tumors. An individual with a malignant tumor usually succumbs to it before a second primary growth develops or before it is recognized.

Multiple primary malignancies are found more often during surgical operations than at post mortem examinations. Hurt and Broders of the Mayo Clinic report 3.34 per cent found at operation. Based on the average of their observers, the incidence is about 4 per cent.

In the series of 5 cases at Cook County Hospital, the colon was more frequently involved in multiple carcinoma than was any other organ; the colon was involved in 13 of the cases of carcinoma reported.

It is generally recognized that many people have a congenital, or acquired, predisposition to cancer; others are probably endowed with resistance. In spite of the tremendous amount of research on cancer it is still very much of an enigma. While the genetic background of cancer is still obscure, we hope that individual and collective reports may help clarify the problem.

It has been quite well established that an inherent or acquired susceptibility to cancer exists in certain individuals. Chronic irritation is recognized as one of the main causes of cancer. We know that chronic irritation may occur in a number of organs in which cancer is likely to occur. For instance gastric ulcer, polyps of the colon and rectum, lacerated cervix, and chronic mastitis. All of these pathological conditions may be considered as forerunners of cancer in a susceptible individual and two or more organs may be involved at the same time. For example, it is not uncommon to have a peptic ulcer and polyps of the colon in the same individual. It does not seem strange, therefore, that we should have multiple primary carcinoma. In fact, it seems rather strange that we do not find them more often. It is quite likely that they are occasionally overlooked.

When a patient is operated upon for cancer careful exploration should be made for multiple carcinoma, as the fact that a malignant growth is present indicates that the patient is susceptible to cancer. If the second primary malignant lesion happens to be in a very early stage it may not be possible to recognize it. Not infrequently a second primary growth may be mistaken for a metastatic growth. In my personal experience I do not recall more than 6 definite cases of multiple primary cancer.

Recently I have had 4 of these cases that seem to be of sufficient interest to present more or less in detail, as they both illustrate certain features which make them seem worth while reporting. In both cases there were two primary malignant tumors, both of which may be considered as having developed simultaneously.

**CASE 1** The first patient, a woman 48 years of age, came to see me in August, 1938, complaining of some rather indefinite abdominal symptoms—general abdominal distress, moderate intermittent distention, and occasional passing of blood from the rectum. As she had hemorrhoids, I assumed that the bleeding came from them.

Because of the symptoms complained of she was sent to a roentgenologist for study of the colon. X-ray examination revealed the presence of a polyp in the descending colon about 7 inches distal to the splenic flexure. A considerable amount of barium was retained by the polyp, a fact indicating the likelihood of a cauliflower type of growth, which was probably malignant.<sup>1</sup>

Operation was performed on September 12, 1938. A midline incision was made at the site of the scar following a hysterectomy performed 7 years previously. The transverse colon was fixed to the cecum by adhesions and the ileum was fixed to the peritoneum at the site of the old incision. These adhesions were freed and the bowel was carefully peritonealized. Exploration of the descending colon revealed the polyp about 7 inches distal to the splenic flexure (Fig 1). Segmental resection of the bowel seemed the safest procedure in order to prevent future formation of polyps. About 7 inches of bowel was removed in this case, by a Mikulicz type of operation. The fistulous tract following the Mikulicz operation was closed on November 21, 1938. Pathological examination of the polyp showed it to be an adenocarcinoma grade 1 (Fig 2).

Seven weeks later the patient came to see me on account of a tumor in the left breast. The tumor had the appearance of cancer, but as she had a

<sup>1</sup>It is suggested by Broders that there is probably a malformation of the bowel which accounts for the formation of these polyps.

Lockart Mummery has studied intensively 50 cases of solitary polyp of the rectum over a period of 1 to 15 years, examining these patients every 4 to 6 months during that time. He found that 50 per cent had recurrence in or near the same area where the original polyp was found. In some instances it was on the opposite wall of the bowel whence it first occurred. Thirty per cent of the patients had more than one recurrence some as many as 9. In some cases recurrence was so frequent that he found it necessary to remove the entire rectum. In twenty five per cent of his cases malignancy developed at the tip of the polyp, but in no case in which the polyp was removed at the base did cancer extend to the bowel wall, showing quite definitely that the early adequate removal of the polyp prevents the development of cancer of the colon or rectum from the polyp.



Fig 2 Photomicrograph of adenocarcinoma of a polyp from the descending colon. Section taken from distal end of polyp, grade 1.

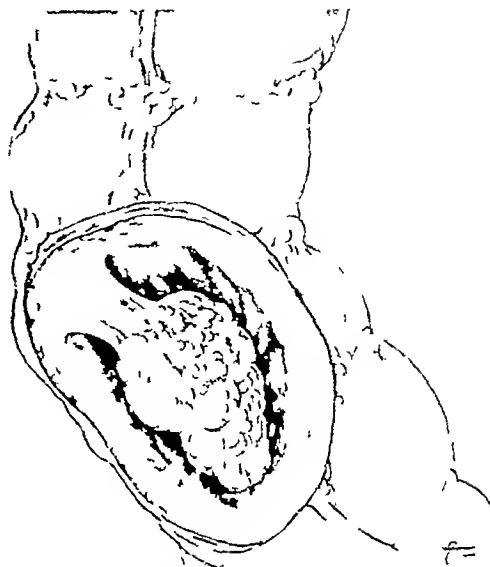


Fig 1 Polyp of descending colon

cold at the time, I had to postpone the operation until February 1, 1939, when the tumor was removed. A frozen section revealed the tumor to be a duct carcinoma (Fig 3). A radical operation was performed. She made a satisfactory recovery from this operation, but returned in 5 months with a tumor in the right breast, which had the gross appearance suggestive of cancer. A complete mastectomy was done, as no malignancy was found, a radical operation was not performed. In June, 1938, a benign cystic tumor had been removed from this breast.

**CASE 2** The second patient, a woman 48 years of age, was seen on January 24, 1939. She stated that about 3

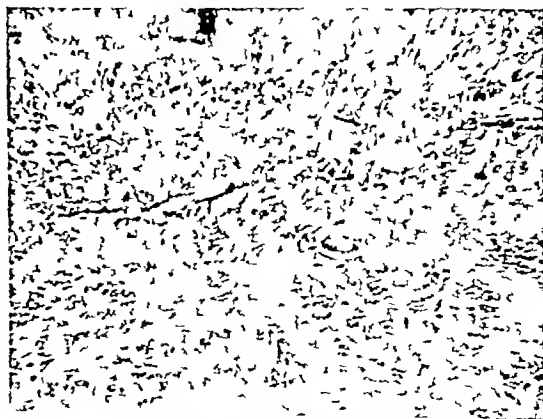


Fig 3 Photomicrograph of duct carcinoma of breast



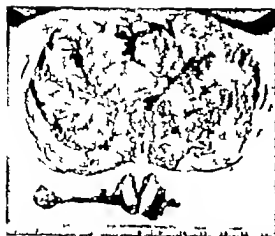


Fig. 4. Photograph of papillary adenocarcinoma of ovary. Uterus and other ovary shown in photograph.

weeks before, she was seized with severe pain in lower right abdomen, which came on rather suddenly; the severe pain gradually subsided. She had been troubled with moderate pain in lower abdomen for several months. Some times the pain would radiate to the left side. Examination revealed the presence of a large pelvic tumor about the size of full term pregnancy. Urinalysis as negative. Hemoglobin as 84 per cent, red blood cells, 4,000,000; white blood cells, 7,500. Blood pressure as 120/90 and pulse ranged between 66 and 80.

It was suspected that on account of the apparent rather rapid growth of the tumor it was probably malignant. She stated that she had been treated for heart trouble years previously by cardiologist and as learned about her



Fig. 5. Photomicrograph of papillary adenocarcinoma of ovary.

heart, she was advised to go to the hospital as soon as there was no indication at this time of any serious heart trouble and there was definite indication for great surgery. She did not take the advice given, however, and was not seen again for days, at which time she stated she was ready to go to the hospital for operation.

Operation was done on February 6, 1930. A midline incision was made, extending from the umbilicus to the pubis. A tumor, bound hard to the abdominal wall and as an attempt to free it, it ruptured before the fluid could be aspirated, and about 4 or 5 quarts escaped. After that, it was quite easy to free the tumor and trace it to its origin, in the left ovary. It had comparatively small pedicle and was quite easily removed (Fig. 4).

The pathological report from frozen section showed papillary adenocarcinoma of the left ovary (Fig. 5). As this type of cancer tends to metastasize to the other ovary, subtotal hysterectomy was done, and the other ovary removed.

The patient was not in very good condition, and every effort was being made to conclude the operation as quickly



Fig. 6. Adenocarcinoma of cecum located base of appendix, causing obstructive appendicitis.

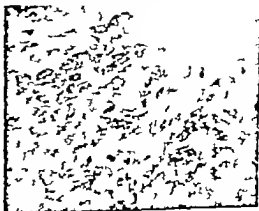


Fig. 7. Photomicrograph of adenocarcinoma of cecum grade 3.

possible. However, on completion of the pelvic operation, an exploration was made and the appendix was found greatly enlarged and inflamed. Examination of the cecum at the base of the appendix revealed a hard mass, which had the gross appearance of carcinoma (Fig 6). Appendicitis, which was present in this case, was undoubtedly caused by the obstruction at the base of the appendix, produced by the gradual extension of the cancer.

Not caring to subject the patient to any more surgery at this time than was absolutely necessary, it was decided that the Mikulicz type of operation was the safest procedure. Accordingly, the mesentery of the ascending colon was covered and vessels ligated. The ileum was sutured to the ascending colon well away from the growth, and the mass including the appendix was exteriorized. Four days later the appendix ruptured. The ileostomy tube functioned well and it was not necessary to remove the growth until 1 week after the primary operation. Pathological report showed the growth to be adenocarcinoma grade 3 (Fig 7). On the ninth day a crushing forceps was placed on the diaphragm separating the ileum and ascending colon. It took the forceps 6 days to cut through the diaphragm.

The external fistula was closed 2 months after the primary operation. Patient has been quite well since, but a recent examination revealed recurrence of cancer, probably it is a recurrence of the papillary adenocarcinoma of the ovary, as that was the more advanced of the two growths.

#### SUMMARY

In Case 1, it was quite evident from the fact that entirely different structures were involved

and the tumors were so far removed from each other that they were independent primary growths. It is interesting in this case that the patient was operated upon 4 different times within a period of 13 months for various tumors. 2 of these proved to be cancers and 2 benign growths, therefore, 50 per cent of the tumors for which she was operated upon during this period, proved to be malignant.

In Case 2, it seems quite likely that the papillary adenocarcinoma of the ovary had probably been present for some time, as it was a low grade type of cancer and very large. The adenocarcinoma of the cecum, on the other hand, had probably started to develop rather recently, as it was still comparatively small. This growth was found to be of a much higher grade of malignancy.

The reason the carcinoma of the cecum was not considered a metastatic growth from the ovary was that there was no evidence of involvement of the serous coat of the bowel, and again the tumor of the bowel had a much firmer feel than the growth in the ovary. The macroscopical appearance of the two malignant tumors was entirely different.



## ESSENTIAL PROBLEMS IN THE SURGICAL TREATMENT OF INGUINAL HERNIA

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THERE is a widespread tendency among surgeons to approach the problem of the surgical treatment of inguinal hernia from the standpoint of the routine application of one or another of the standard operations rather than from an analysis of the actual anatomical defect to be repaired. Operation for hernia is frequently among the first to be entrusted to the initiate in surgery, and the conceptions of treatment thus early acquired are usually accepted without question and are often permanently retained. Discussions on the subject, therefore, frequently resolve themselves into testimonial meetings, affirming the value of this or the other method or technical detail or suture material, without regard for the essential underlying pathological features of the disease to be treated. The purpose of this paper is not to advocate any one specific treatment for inguinal hernia, but to redirect attention to the actual surgical problems it presents.

In order to clear the ground for a rational consideration of the hernia problem, several sources of confusion must be eliminated. First, there is a widespread complacency as to the results obtained by the surgical treatment of inguinal hernia. This satisfaction is usually based upon impression, or upon the assumption that failure of patients to return is indicative of a successful end-result of the operation. When the acid test of actual follow-up examination is applied, however, the results are found to be much less satisfactory and, in the case of direct hernias, profoundly disconcerting. Statistics as to the late results of surgery in indirect hernia (15) report recurrence rates ranging from 1 to 20 per cent. The results in direct hernias are definitely poorer. In their highly significant paper entitled "Direct Hernia: A Record of Surgical Failures," Andrews and Bissell (3) reported their own recurrence rate to be 27 per cent, and tabulated results from other clinics which ranged from 9.5 to 32 per cent. The average rate for the entire table was 20 per cent. Gallie (7) states that records from hospitals in which this subject has been studied show that recurrence takes place in from 40 to 50 per cent

of the cases. With these figures in mind, let us demand that all statements attesting the value of any therapeutic measure for the control of inguinal hernia shall be based upon nothing less than the actual follow-up examination of patients after the lapse of an adequate postoperative time.

A second fact to be emphasized in bringing the discussion of the treatment of hernia to a logical basis is that there are no consistent differences obtained with the various standard operations for hernia. Individual surgeons may report better results with one method as against all others; but, when the literature as a whole is surveyed, the same may be found true of the other procedures in turn. No one method regularly yields significantly better results than do the others. Nevertheless, one hears the merits of the routine techniques debated with great heat, as if acceptance of one or another is the secret to successful herniorrhaphy.

Much of the confusion attending discussions on the treatment of inguinal hernia is due to the failure to differentiate adequately between direct and indirect types. Sufficient clinical and investigative data have been accumulated to indicate that these are two distinct diseases, based upon different congenital anatomical predisposing characteristics, producing different defects, requiring correspondingly different surgical attacks, and with similarly different prognoses. An attempt will be made here to define the actual lesion present in the different types of inguinal hernia and to indicate the essential problems in its logical repair.

A final source of confusion in speaking of inguinal hernia is the ambiguity and inaccuracy of anatomical description and nomenclature applied to the structures occupying the inguinal region. The anatomy of this area, with special reference to the problems of inguinal hernia, has recently been studied by Anson and McVay (4, 5, 6) in the anatomical laboratories of Northwestern University Medical School. The following résumé is based upon their descriptions.

### ANATOMY OF THE INGUINAL REGION

The structures comprising the spermatic cord—the vas deferens, and the spermatic vessels (and

From the Division of Surgery, Northwestern University Medical School and the Michael Reese and Chicago Memorial Hospitals.

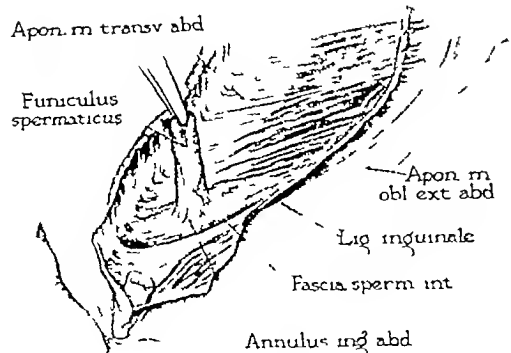


Fig 1 Abdominal inguinal ring as seen from in front.

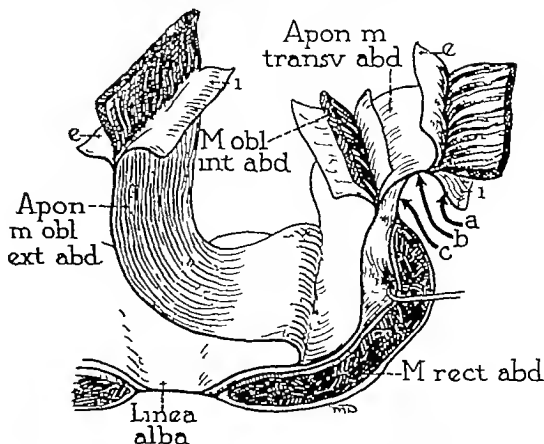


Fig 2 Section demonstrating muscles of the abdominal wall and their investing fascias, below the level of the linea semi-circularis (From Anson and McVay, loc cit, 4)

in the female, the round ligament) course in the retroperitoneal tissues to converge at the abdominal inguinal ring. This is a hiatus in the posterior fascial wall of the inguinal canal, usually referred to in the surgical literature as the "transversalis fascia," and through it the cord structures leave their retroperitoneal position to traverse the abdominal wall on their way to the scrotum. The orifice is not a circular opening as the term "ring" would imply, but rather, a funnel-shaped aperture, the fascial fibers continuing down over the cord as the internal spermatic fascia (Fig 1).

The posterior fascial wall of the inguinal canal, as stated, is usually referred to as the transversalis fascia. This structure is importantly regarded in current discussions of inguinal hernia, and there is some disagreement as to its origins and continuations. Anson and McVay emphasize the fact that each of the flat muscles of the abdomen, as well as those elsewhere, has an anterior and a posterior investing fascia. These investing fascias are continued over the aponeurotic fibers of the muscles, so that aponeuroses consist of three fibrous layers, the true tendinous fibers of insertion and the two investing membranes. The term "transversalis fascia" is usually used to denote the posterior investing fascia of the transversus abdominis muscle. When the muscle ends in an aponeurosis, however, the term is applied to that portion of the triple aponeurotic layer that extends caudally beyond the lowermost fleshy fibers to its insertion in the pubic bone. Mesially, this layer passes *anterior* to the rectus muscle, together with the other portions of the transversus abdominis aponeurosis below the semicircular line of Douglas, to contribute to the anterior rectus sheath. The posterior investing layer,

however, splits at the edge of the rectus muscle, and its very thin posterior half passes behind the rectus as its posterior investing fascia (Fig 2).

The transversus abdominis aponeurosis (transversalis fascia) alone constitutes the posterior wall of the inguinal canal, and upon it the spermatic cord lies (Fig 3). The only other structure lying behind the cord, and contributing to the strength of the posterior wall is a lateral expansion of the insertion of the rectus muscle outward onto the pectineal line of the pubis. This has often been called the aponeurotic inguinal falx. The term is confusing, however, because, unfortunately, it has also been applied to the so called "conjoined tendon." The expanded rectus tendon, when present, lies immediately superjacent to the transversus layer. Data as to the percentage of subjects in which it was found, and the variations in its width, will be presented in a forthcoming publication by the authors mentioned.

As the spermatic cord comes through the internal ring, it is covered by the arching fibers of the internal oblique muscle. This muscle constitutes an effective sphincter, guarding the introitus of the inguinal canal. The lower fibers of this muscle take their origin from the pectineal fascia (9), just posterior to the inguinal ligament, and insert fan-wise into the linea alba down to and including the pubic tubercle. Those arising inferior to the abdominal inguinal ring invest the cord structures in loose loops and comprise the cremasteric layer of the cord. In most subjects (Fig 4), including those with indirect inguinal hernias, the entire inguinal region between the

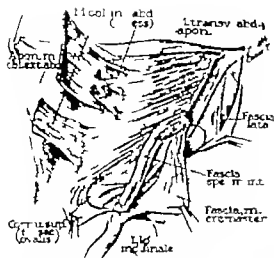


Fig. 3. Transversus abdominis aponeurosis forming posterior wall of the inguinal canal. (From McVay and Larson, loc. cit., 9)

inguinal ligament and the rectus sheath is covered and protected by this muscular layer with only a slight interspace, largely artificial, between the abdominal and cremasteric portions of the muscle. When this type of internal oblique muscle is present, direct hernia does not occur. The arrangement predisposing to the development of direct hernia will be described later.

The importance of the internal oblique muscle in safeguarding the inner opening of the inguinal canal cannot be overemphasized. Its action has been likened to that of a sphincter or shutter. When the abdominal muscles contract to increase the pressure within the abdomen, the fibers shorten and approximate themselves to the inguinal ligament, compressing the cord. The efficacy of this sphincter can be demonstrated when local anesthesia is used in operations for indirect inguinal hernia. If a finger is inserted into the sac, extending into the abdominal cavity and the patient strains or coughs, the muscle can be felt contracting down upon the finger like a true sphincter. That it really functions in this capacity is demonstrated by two frequently observed clinical facts. The sac of indirect hernias is very often found to have a band of fibrosis or of traumatic peritonitis encircling it at its neck, as has been described by Schragar and Gault, the result of sphincteric muscle pressure upon it. More striking still is the fact that many patients with inguinal hernias reach adult life without be-

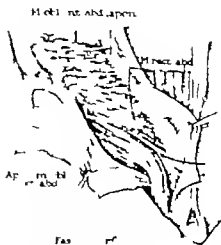


Fig. 4. Internal oblique muscle showing narrow cleft between abdominal and cremasteric portions. (From Larson and McVay, loc. cit., 4)

coming aware of the existence of the hernia. A certain number of these have sacs of the congenital type in which the peritoneal sac is continuous with the tunica vaginalis testis, indicating beyond doubt that the hernia has been present since birth. The ordinary types of indirect hernia are also generally considered to be of congenital origin. Nevertheless, thanks to the efficiency of the internal oblique sphincter no bowel or omentum finds its way into the sac until adult life or even middle age is reached. Another expression of this sphincteric resistance is the difficulty sometimes encountered in recently discovered hernias, in bringing contents down into the sac during examination. Equal difficulty may be met in reducing the hernia when once it has been brought down and strangulation, when it does occur, usually takes place at the internal ring.

The anterior wall of the inguinal canal is formed by the aponeurosis of the external oblique. This hard, fibrous layer supports the muscular flaps of the canal as a tire casing does the inner tube. A hiatus in the fibers of the aponeurosis provides the subcutaneous or external inguinal ring through which the cord gains access to the scrotum. The inguinal ligament is a fold of the external oblique aponeurosis stretching from the anterior superior iliac spine to the pubic tubercle. It is usually described as a fixed structure continuous with the fascia lata of the thigh, and because of this serves as the sheet anchor in most hernial repairs, the other layers being brought

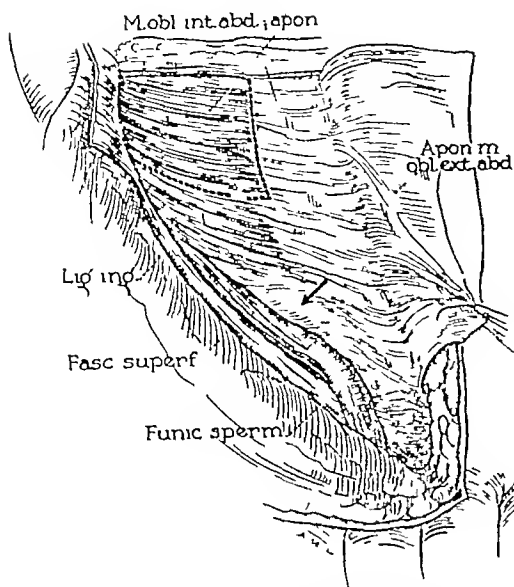


Fig 5 Type of internal oblique muscle predisposing to the development of direct hernia. Note absence of muscle fibers in lower portion (From Anson and McVay, loc cit, 5)

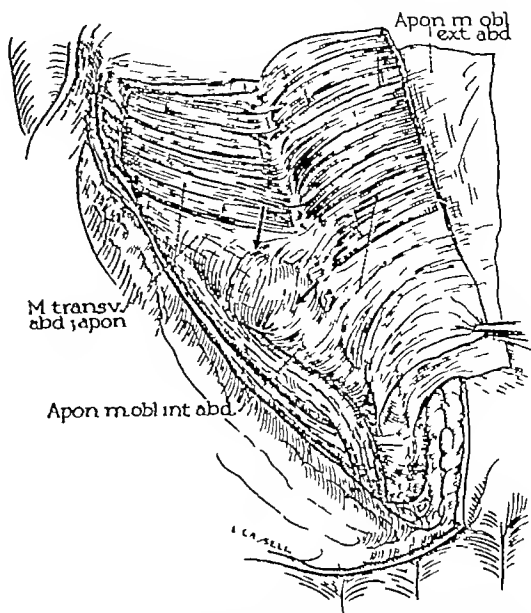


Fig 6 Transversus abdominis layer from same subject as Fig 5. Note direct hernia forming (From Anson and McVay, loc cit, 5)

down and sutured to it. McVay (8) has recently pointed out that the aponeurotic fibers end in a free edge, and the only attachment between the inguinal ligament and the thigh fascia is by means of the very thin investing fascia. This he considers a fundamental fallacy in the Bassini and allied herniorrhaphies.

The inguinal canal bounded by the structures described is the passage pursued by the spermatic cord through the abdominal wall. It is a long, oblique, valve-guarded channel, similar in design to the intramural portions of the ureters or of the common bile duct. Wherever, indeed, in the body a duct enters or leaves a hollow viscus, the pattern is the same, and for the same reason. Just as increased intravesical tension from the contraction of the bladder musculature during the act of micturition compresses the intramural portions of the ureters, and forces urine out through the urethra rather than back up into the ureters, so contraction of the abdominal muscles increases the pressure within the inguinal canal, constricting and narrowing it to prevent the escape of abdominal contents.

#### ETIOLOGY OF INGUINAL HERNIA

There is general agreement today, as has been stated, that indirect and direct hernias are totally different diseases, each dependent upon a differ-

ent developmental defect, each having its own anatomical and pathological characteristics, and presenting, consequently, its own prognostic and therapeutic problems. Indirect hernia is due primarily and solely to the persistence *in toto* or in part of the processus vaginalis testis. No other developmental defect regularly accompanies this common type of inguinal hernia. In all other respects the abdominal parietes conform to the normal described. Only the persistence of an embryonic structure can lead to the development of a hernia through the internal ring. There is no evidence that any amount of force or trauma can otherwise produce such a protrusion.

The evidence for this rather dogmatic statement lies in the unvarying position and attachment of the sac with reference to the cord structures. Whether the hernia is of the "congenital" or the ordinary type, these relations are identical. The sac always lies in the middle of the cord, immediately anterior to, and in direct apposition with, the vas deferens, and is covered by the cremasteric and internal spermatic fascial layers. An areolar type of tissue connection binds the sac to the other components of the cord. Unless modified by pressure or inflammation, these anatomical findings are the same. They are too constant to be the result of an accidental rupture through the abdominal wall and can be explained

only on the basis of the persistence of a normal embryological structure.

Given a preformed peritoneal process communicating with the abdominal cavity and extending into or through the inguinal canal, manifest hernia need not necessarily occur. The sac may remain empty for many years, and even throughout life. This is possible, as has been detailed, by virtue of the function of the internal oblique sphincter. In most individuals with a congenital sac, however omentum or bowel finds its way down past the sentinel at the internal ring at some time during childhood or in adult life, and the hernia becomes manifest. When herniation does occur the ring becomes stretched and dilated, either suddenly and abruptly following strain or injury and accompanied by pain and tenderness, or gradually silently and imperceptibly. In either event, subsequent platonizing back and forth of omentum or intestine results in increasing enlargement of the inner ring. This enlargement cannot progress upward, because of the protection afforded by the transversus abdominis and internal oblique muscles. Necessarily therefore, it enlarges downward and, in so doing, comes to extend beyond the overhanging and protecting internal oblique sphincter. Thus, a stage is soon reached wherein sphincter control is entirely lost, and contents glide in and out of the canal with changes in abdominal pressure or of bodily position.

In very old, very large hernias, particularly in those in which a truss has been worn for a long period, further changes involving the musculo-fascial wall may be produced. In such cases, the internal ring may extend from its original position above and lateral to the inferior epigastric vessels down to the pubis. In addition, the overlying muscles which had developed normally may undergo atrophy and atrophy from excessive stretching as well as from truss pressure. When this has occurred, the situation approaches that found in direct hernia, and a similar solution is required.

Direct inguinal hernia begins as a disease totally apart from the indirect variety. It, too, is based upon a congenital developmental anomaly but one that is entirely different from the one responsible for indirect hernia. As was pointed out in a recent contribution (14) direct inguinal hernia is due to failure or absence of the lowermost fibers of the internal oblique muscle. In the normal subject herein described, the entire inguinal region is covered and protected by the internal oblique muscle, a narrow cleft separating its abdominal from its cremasteric portions. The

interval between the lateral border of the muscle and the inguinal ligament is just large enough to accommodate the cord with its cremasteric covering. Thus, no portion of the canal floor is left without muscular protection.

In a certain number of persons, however the lower oblique fibers of the muscle are absent, its fleshy body ending with more or less horizontal fibers arising at the level of the internal ring and inserting into the rectus sheath (Fig. 5). This leaves a triangular area of variable size in which there is no muscular covering for the transversus aponeurosis constituting the posterior wall of the canal. This area, called the inguinal triangle, is bounded above by the lower free margin of the internal oblique, by the rectus sheath medially and the inguinal ligament laterally. The range in size of this space as seen in anatomical dissections and also during operations for direct hernia was tabulated in the previous publication.

In persons with this type of abdominal musculature, the entire intra-abdominal pressure is exerted upon the aponeurotic floor of the canal. The capacity of this membrane to withstand pressure will depend largely upon its inherent strength and firmness. If as a result of the innumerable ailing strains incident to daily life and work or conceivably because of some sudden and excessive strain or trauma, the transversus structures prove inadequate, direct hernia will result. Such herniations are, characteristically loud bulgings through stretched and weakened aponeurotic fibers.

#### TREATMENT OF INGUINAL HERNIA

With this anatomical and pathological background, it is possible to define the problems encountered in the treatment of inguinal hernia. Indirect hernia, as stated, is a protrusion into a preformed sac with, usually secondary dilatation of the internal ring. Logical treatment, therefore, should consist in removing the sac and narrowing the ring to its normal dimensions. When these two steps are accomplished, the inguinal canal has been restored to a normal state, and further building up of its posterior wall by plicating and re-plicating the various and sundry layers of muscle and fascia have no bearing whatever on preventing eventual recurrence of the hernia. Direct hernia, on the other hand, is a protrusion through a torn and stretched posterior fascial wall, due to the absence of overlying muscular support. Here the problem, in its essentials, is the repair of a hole in the fascial floor of the canal and its subsequent reinforcement to prevent further herniation. Since there is no way of making

muscle grow where it is wanting, a fascial plastic operation must be done. Thus, the two types of inguinal hernia present totally different problems which would appear logically to demand totally different operative attacks. Nevertheless, most surgeons today utilize the same operative procedures for both types of hernias.

**Repair of indirect hernia.** The problem in indirect hernia has been defined. It consists of a preformed sac with, usually, some dilatation of the internal ring. Everyone is agreed that treatment should begin with removal of the sac. The emphasis, however, which is frequently placed upon extirpation of the sac by its roots, often with a portion of the normal peritoneum is, in my opinion, exaggerated. The peritoneum is an elastic and yielding membrane and a dimple in its surface would not be an important factor in the production of a hernia if there were no fascial defect through which the dimple could protrude. In infants and children, and in older individuals with very recent hernias that have as yet caused no dilatation of the ring, simple removal of the sac is all that is necessary to restore the affected inguinal canal to normal. Hertzfeld, in an "experience of many thousands of cases," finds that simple removal of the sac is all that is required for the cure of hernias in infants. Numerous other writers have expressed a similar view, and I have found this limited procedure adequate whenever the ring is of normal diameter.

The usual indirect hernia encountered at the operating table exhibits, however, an enlarged internal ring superimposed upon the preformed sac. Rational treatment it would seem would demand narrowing of the ring after the sac has been removed. This is readily accomplished by placing a stitch or two, or possibly three, in the transversus layer. In order to visualize the ring the cord is held upward and the internal oblique is retracted medially. The dilated internal ring thus exposed is usually triangular in shape with its apex directed downward. The inferior epigastric vessels may be seen crossing its lower angle. The hiatus which is normally completely occupied by the cord will frequently permit considerable bulging of preperitoneal tissue and will often admit two or three fingers alongside the cord. Closure should be from below upward so that the opening left may be as high as possible and the cord as snug and as oblique as in the normal because the lateral end of the ring is very narrow. Usually one deep medial edge of the transversus muscle is sutured to the internal inguinal ligament with several cross sutures (Fig 7). No tension is required to be placed on the suture.

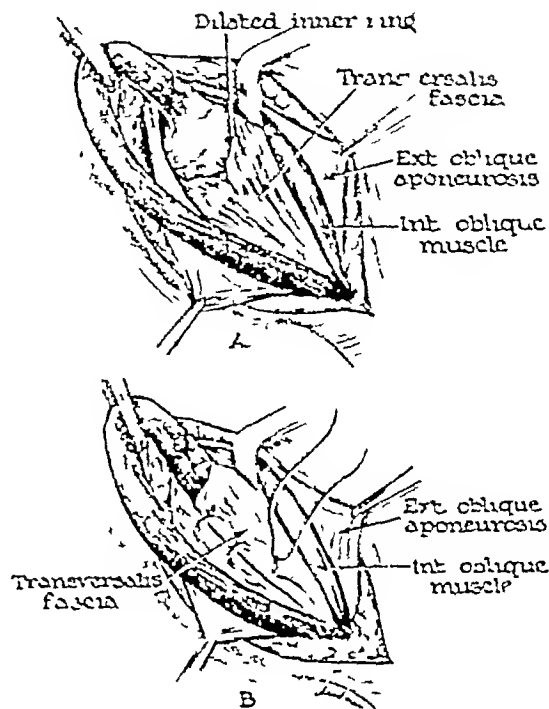


Fig 7. Repair of indirect inguinal hernia after sac has been removed. A. Dilated internal ring with preperitoneal fat bulging through it. B. Closure of ring by suture of its medial margin to inguinal ligament. Internal oblique muscle is retracted medially and a cross suture is in the suture layer.

When the ring is closed, the canal has been restored to normal, and further operation manipulation is superfluous. The cord is then dropped back in its original position and the external oblique reunited.

It will be noted that suture of the internal oblique muscle (the so-called cord interposition) to the inguinal ligament is not a part of the operation. This step which comes in the original feature of the Bassini operation and in its modifications, is avoided in the present operation for both indirect and direct inguinal hernia because it is irrelevant and ineffective. It is positively injurious. For these reasons, if the enlarged upon there is a good reason that the Bassini operation should be abandoned in place with the other historical operations to surgery that have in time become obsolete.

Suture of the internal inguinal ligament is irrelevant and unnecessary. It passes to hold up the cord, which is already held up by the external oblique aponeurosis. By definition and by practice, the internal inguinal ligament is not a part of the inguinal canal.



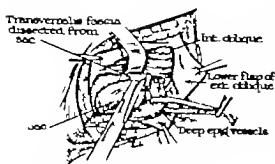


Fig. 8. Direct hernia. Method of freeing sac by locating fibers of transversalis fascia.

through the internal ring and, in most cases, there is nothing wrong with the posterior wall of the canal. Suture of the internal oblique across the posterior wall not only does not contribute to the repair of the actual lesion present, but gives the surgeon a false sense of security in the feeling that he has built up a firm inguinal floor and tends to lead him to omit the one really pertinent step required, namely the exposure and suture of the dilated internal ring.

The Bassini step in addition to being irrelevant to the purposes of the operation, is also ineffective. It has frequently been shown (61) that muscle and fascia do not unite firmly and failure of union of the internal oblique with the inguinal ligament is regularly found at operations for recurrent hernia. The term *conjoined tendon* is avoided deliberately in this discussion because it is at best a euphemistic misnomer. The surgeon is often seen taking a stitch into fleshy red muscle, saying as he does so that he is suturing *conjoined tendon* to the inguinal ligament, and this term is almost invariably used in descriptions of operations for hernia. It must be obvious that contracting, living muscle cannot be sutured, with any expectancy of permanent union, to a rigid and unyielding structure with stitches that draw the muscle fibers out of their normal line. When contractions of the abdominal muscles are resumed, there is a pull on the suture line, and if the sutures do not yield, they must cut through leaving perhaps, a narrow scar to mark their former location. The proof as stated, of the inadequacy of muscle-to-fascia union is the finding at operation for recurrent hernia that these structures have pulled away and have returned to their original positions.

Definite injury to useful structures may result from this procedure. The significance of the internal oblique muscle as the sphincteric safe-

guard at the introitus to the inguinal canal has been described. Suture of this muscle with its attendant deformity fixation and cicatrization must certainly impair its capacity to function. This damage outweighs any possible benefit derived from a Bassini suture.

Perhaps the greatest injury to the canal is done in those operations that attempt to provide maximal strength for the posterior wall by bringing all of the layers behind the cord, displacing this latter structure to the subcutaneous position. Nature's mechanism of providing a valvular outlet for the cord is thereby defeated. The patient is left, instead, with a short straight canal which is in direct line with the intra-abdominal force. The wall cannot be sutured snugly enough about the cord, in these operations, to prevent recurrence of the hernia without strangulating the cord. Perhaps, because of the intermittent expansions and contractions with the pulsations of the spermatic vessels, the cord works itself loose and a hiatus occurs about it. The findings at reoperation in such instances are almost invariably the same. There is a direct protrusion of peritoneum just above the cord leading immediately into the subcutaneous tissue. The problem of repair of such recurrence may be difficult since further tightening of the wall about the cord offers no greater security than did the original one, and the musculofascial wall has often been sufficiently damaged to make the return of structures to their normal relations no longer possible.

In old, large long-standing indirect hernias, particularly if a truss has been worn for a long time, there may be destruction of the entire posterior canal wall from pressure of the hernial contents. In addition, there may be atrophy, relaxation, and attenuation of the overlying musculature, with even fragmentation of the external oblique aponeurosis. In such cases, the findings are analogous to those in direct hernias, and similar problems are presented. The therapeutic solution to these problems will be discussed below.

*Repair of direct hernia* The essential therapeutic problem in direct hernia consists of a defect in the fascial floor of the canal due to insufficient support from absence of the overlying muscles. The inadequacies of the conventional operations are more glaringly obvious than in the indirect variety. Andrews has pointed out that the usual procedures attempt to close a triangular defect by sewing together the sides of the triangle. The larger the defect, the more tension will be required to bring the internal oblique muscle to Poupart ligament. That the usual method are

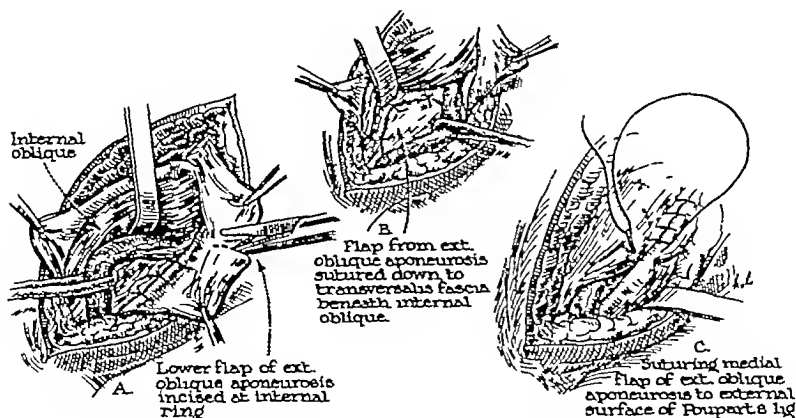


Fig 9 Repair of direct hernia Transversus aponeurosis sutured to inguinal ligament and reinforced with flap from lateral leaf of aponeurosis of external oblique

inadequate is revealed by the statistics herein cited, showing recurrences in from one-third to one-half of the patients operated upon. Because of these poor results, and because the patients are often made worse by an unsuccessful operation, Andrews has advised against operation in the usual cases of direct inguinal hernia.

Logical solution for the problem of direct hernia should consist of repair of the hole in the transversus layer (transversalis fascia), and reinforcement of the repaired fascia by some type of fascial plastic operation. Treatment begins by freeing the sac from the stretched and torn fascial fibers coursing over it, and inverting it into the retroperitoneal position. There is no point in opening the sac in the usual direct hernia because the sac is not long and finger-like as it is in the indirect variety, but is a short, blunt, dome-shaped bulging through the fascial floor. These sacs are frequently fatty and opaque. This, plus their median position, increases the danger of injury to the bladder. It is safer, quicker, and just as satisfactory merely to return the unopened sac to the retroperitoneal space and to close the fascia over it.

An exception to this rule is the relatively infrequent diverticular type of direct hernia. Here, the sac emerges through a small, sharply defined aperture which is usually situated near the lateral edge of the rectus muscle. Such sacs are long and finger-like, and are subject to strangulation because of the sharp margins of the ring. They should be opened, emptied of their contents, and removed just as is done in indirect hernia.

The technique for the usual type of sac is shown in Figure 8. The thinned and attenuated

fascial fibers are cut with scissors around the entire base of the sac. This completely liberates the sac and provides a free edge of fascia for suture. The sac is then inverted and the fascial edge brought down to the inguinal ligament with interrupted sutures of fine silk. This is a mobile layer, and no tension is required for bringing it into apposition with the inguinal ligament. Fascia is approximated to fascia, and normal relationships are restored.

It is obvious, however, that the normal relationships were inadequate, or the original hernia would not have developed. Strengthening of the transversus layer is, therefore, the second requirement of the operation, and this can be adequately accomplished only by reinforcing it with another firm fascial layer which should be brought into immediate apposition with it over a broad surface, without tension and with no interposition of any other type of tissue. The reinforcing fascia may be in the form of strips or sutures, or may be a solid transplant, either pedicled or free. A flap or patch would appear to be firmer than a lattice from weaving fascial strips, and a pedicled flap possesses the obvious further advantage of retaining its blood supply and, thereby, offering better prospects of union and survival.

Pedicled flaps of firm, white fibrous fascia may conceivably be brought over the newly repaired inguinal floor from above or from below. The "white fascia" operation of Andrews brings the medial flap of the aponeurosis of the external oblique over the transversalis fascia and sutures it to the inguinal ligament. This may, in turn, be further strengthened by imbricating over it the

lateral flap of the aponeurosis. Similar fascial tissue may be derived from the anterior rectus sheath, by turning down a flap broad enough to reach to the inguinal ligament. All methods, however of bringing the reinforcing fascia down from above have the common objection that whatever internal oblique muscle tissue is present will be interposed between the two fascial layers.

This objection can be overcome only if the reinforcing layer is brought up from below. It can then be insinuated between the internal oblique and the transversus, and come to be in immediate apposition with the newly repaired transversus fascia. Several such methods have been described. Turner cuts a flap from the fascia of the thigh and brings it deep to the inguinal ligament to cover the inguinal area. Wangenstein turns up a pedicled flap from the iliofemoral tract. This is an excellent method for repairing major defects of the abdominal wall, but he does not advise it for the routine direct hernia. For a number of years, I (24) have used a flap from the outer leaf of the aponeurosis of the external oblique to reinforce the transversus fascia. This method is technically easy. It fulfills the requirements of a logical procedure for the problem at hand, and it has yielded sufficiently good results over this period of three to bring direct hernia definitely within the scope of operable conditions.

The technique of this method is illustrated in Figure 9. The lateral flap of the aponeurosis of the external oblique is incised obliquely downward opposite the internal ring and the flap thus formed is brought beneath the cord. The internal oblique muscle is separated from the transversus layer and held upward with a retractor while the flap is sutured down to the subjacent transversus fascia. The internal oblique is then allowed to drop back into its normal position covering the suture line as a trap door. Nerves are placed in the internal oblique layer.

The final step in the operation consists in reconstructing the anterior wall of the canal. In order to obviate weakness or relaxation at the site of the incision in the lateral leaf of the external oblique aponeurosis, the cut edge is brought up under the medial flap of aponeurosis with one or two mattress sutures. This medial flap is then brought over the cord and sutured to the outer surface of the inguinal ligament. A new external ring may be fashioned by means of a pursestring suture in Scarpa's fascia.

This procedure meets the requirements of a logical repair for the usual forms of direct hernia. The aponeurosis of the external oblique is almost invariably adequate for a reinforcing flap. Only

fibrous tissue is sutured to fibrous tissue and the layers are approximated to one another over a broad surface without tension and without interposition of other tissue. Silk sutures are used throughout. The time required for the operation does not exceed that required for the usual types of repair. Since no structures are brought together under tension, there is no contra-indication to repairing both sides of bilateral hernias at one sitting. While no further follow up studies have been made since the original description of this method, the results continue to be sufficiently satisfactory to warrant the continued use of this operation in all direct hernias, and in those old, large, neglected indirect hernias in which the therapeutic problem is essentially the same as that of direct hernia.

#### SUMMARY AND CONCLUSIONS

A widespread tendency exists to approach the problem of the surgical treatment of inguinal hernia from the standpoint of routine application of one or another of the standard operations, without due consideration to the actual anatomical lesion to be corrected. Unwarranted complacency as to the results of operative therapy, inaccuracy and ambiguity of anatomical description, and inadequate differentiation between indirect and direct hernias contribute to the confusion attendant upon discussions of this subject.

Indirect and direct inguinal hernias are two distinct diseases. Each is based upon a different congenital anatomical predisposition, and each produces a different type of lesion. The prognosis in the two types differs widely and appropriately different surgical attacks are required.

Indirect inguinal hernia is due solely and entirely to the persistence of the processus vaginalis testis. In the earliest stages, this pre-formed sac constitutes the only deviation from the normal. Later there is superimposed a secondary dilatation of the internal ring, from pressure of the hernial contents. In late neglected, massive hernias, atrophy and attenuation of muscle and fascia converts the problem essentially into that of direct hernia.

Direct inguinal hernia is due to congenital absence of muscular support to the inguinal floor from deficiency of the lowermost fibers of the internal oblique muscle. The transversus aponeurosis is inadequate to withstand the intra-abdominal pressure and direct hernia results. The essential lesion is a defect in a fascial structure due to lack of overlying muscular support.

The standard operations for inguinal hernia, consisting of the Bassini method and its numerous

# ZIMMERMAN SURGICAL TREATMENT OF INGUINAL HERNIA

modifications are not pertinent to these problems, and may be definitely injurious. Logical treatment for indirect hernia should consist of ablation of the sac and narrowing of the dilated internal ring. Direct hernia requires closure of the hole in the transversus layer and reinforcement with some type of fascial plastic procedure. An ideal operation should approximate fascia to fascia over a broad surface, without tension and with no interposed muscle or fatty tissue. If possible, the reinforcing fascial layer should retain its sources of blood supply. Methods for accomplishing these requirements are described.

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## TREATMENT OF CERVICAL NODES IN INTRA ORAL CANCER

JAMES J. DUFFY M.D. F.A.C.S., New York, New York

THERE is probably no more moot question in cancer therapy than how to treat the cervical nodes in intra-oral cancer. Not only do the methods in general vary but the same man may change his approach as new cases with practically the same manifestations present themselves at his clinic. Thus, a study of the literature dealing with the surgical treatment of cervical lymph nodes in intra-oral carcinoma fails to reveal a definition of operability. The statistical reports are based, in nearly all instances, on all the cases subjected to a neck dissection, with little or no classification of the cervical metastases. This same condition prevails in the radiological literature regarding the treatment of the cervical nodes by irradiation. The figures are usually so massed that it is impossible to ascertain the stage of the disease that has been cured or treated by irradiation. In the surgical approach the nodes may be found to contain metastatic cancer after excision. In the irradiated cases, proof of metastases is often lacking. Only lately has the presence of cancer in nodes been proved by aspiration biopsy. This method of diagnosis is not universally used, and when utilized is adequate only when a positive diagnosis can be made microscopically. A negative report is not conclusive. The clinical diagnosis of the presence of cancer in a cervical node is notably unreliable. The error ranges from 15 to 35 per cent, that is, one-sixth to one third of the cervical nodes presenting what appear to be signs of cancer are shown, on microscopic examination to be hyperplastic inflammatory nodes. Some reports give even higher percentages of error. It is obvious that statistics based on unproved statements of cancer in cervical nodes are most unreliable. Moreover the reports are most frequently based on cancer of the lip—a lesion made up of an adult type of cell, slow to metastasize and also limited in the extent of the metastases. The scope of surgery is more extensive in lip cancer than in the intra-oral group of carcinoma. The intra-oral group of carcinoma presents somewhat different problems from those encountered in lip cancer and only these will be considered in this discussion.

From the Memorial Hospital

The treatment of the cervical nodes has progressed from local excision, to radical dissection to bilateral dissection even when no nodes were palpable to extensive irradiation in all types of cervical manifestations. During the past few years in many clinics, the trend has been the elimination of radical surgery so that we are approaching the stage when the irradiation is becoming too radical to the exclusion of surgery. It is not yet time to discard all surgery in favor of irradiation. Nor can surgeons disregard irradiation therapy of the neck in certain types of intra-oral carcinoma. A narrow point of view will serve only to discredit that method which is overdone to the exclusion of the other procedure.

This presentation offers my criteria for surgery or irradiation of the cervical region in cases of intra-oral carcinoma and all the manifestations from type and extent of the primary lesion to the general condition of the patient are taken into consideration. It is not possible to present statistics to prove all these criteria but figures are available for those conditions which are the source of most of the arguments. The other criteria are based on clinical judgments, and there is little or no disagreement. The basis for this presentation is a consecutive series of 335 cases of carcinoma of the lateral border of the tongue from 1931 to 1935 inclusive. In all cases the diagnosis of the primary lesion was proved by microscopic diagnosis. The proof of the diagnosis in the secondary manifestation was not uniformly proved, but this phase is explained and discussed in the related portion of this paper.

It is the purpose of this paper to discuss the manifestations sequentially starting with the control of the primary tumor and continuing throughout the several local, regional, and distant manifestations, to the general condition of the patient. The subject will be approached from a surgical point of view with the understanding that the contra-indications to surgery are the indications for radiation except in the very advanced cases in which no treatment by surgery or irradiation should be undertaken.

*Controllability of primary lesion.* In this series of 335 cases of carcinoma of the lateral border of the tongue, 8 patients died of intercurrent dis-

ease or were lost before it could be ascertained whether or not the primary disease could be controlled. Of the 307 patients who survived for varying periods of time which seemed adequate to make some estimate of the primary lesion, in 64 per cent the disease was apparently controlled and in 36 per cent it was uncontrolled. Of the controlled cases, some patients have remained well for 5 years or more, many have died of local or distant metastases or concurrent disease. Of the 110 other patients showing uncontrolled disease (36 per cent), nearly all have died—some with only local persistence of the disease, but most of them with both primary and secondary disease. One patient lived many years with disease present, but it is questionable whether it was persistent disease or multiple lesions. However, this case is rated in these statistics as a failure to control the primary disease.

The cases that were uncontrolled were not limited to the advanced primary lesions. Of these 110 uncontrolled primary lesions, 69 were in an advanced state of development and 41 would be considered early or borderline. This estimate is on the basis of clinical judgment, whether the lesion was extensive, involving much of the tongue or adjacent mucosa of the mouth, or whether the growth was limited to a portion of the tongue, roughly within 5 to 6 cubic centimeters in volume. It is to be noted that 63 per cent of the uncontrolled lesions were advanced primary lesions. Therefore, a neck dissection is not indicated when the oral lesion is advanced, until the primary disease is entirely eradicated. Since 36.5 per cent of the early primary lesions persist in spite of treatment, it is more advisable to delay surgical care of the cervical region until there is an assurance that the primary lesion is controlled. This required interval of time may be devoted to moderate external irradiation, thereby obtaining some growth restraint, but not damaging normal tissue to the extent that neck dissection will be impossible.

It should be noted that not all patients with the uncontrolled primary lesions died. In this uncontrolled class were included not only those patients who showed persistent disease to death, but also those patients in whom a partial glossectomy was indicated for infection or fibrosis or both, and in whom the microscopic appearance of the tissue removed indicated that cancer cells were still viable. The conclusion must be that radical surgery of the cervical region should be delayed until the primary lesion is apparently controlled.

*Extent of primary lesion.* If the primary lesion involves both sides of the oral cavity—except

lesions of the lip if these are included in the oral group—a neck dissection is not indicated. Such involvement may be observed in central lesions, such as those in the base of the tongue or in the soft palate, or the lesion may originate on one side and extend to the opposite side, as is frequently noted in carcinoma of the lateral border of the tongue.

In this series of cases, the extension of the primary disease beyond the midline of the oral cavity was observed in nearly 25 per cent of the cases—in the more advanced cases usually with extensive unilateral or bilateral cervical metastases.

When this disease has extended to or beyond the midline, the metastatic nodes have usually reached a stage of development well beyond operability. If there is only unilateral palpable involvement of nodes, it is quite likely that when the primary disease has so far extended that the opposite side of the tongue is involved, metastases will be manifest soon in the other side of the neck, but surgical excision is contra-indicated for other reasons: first, it is unlikely that the primary lesion can be controlled, and second, bilateral neck dissection has rarely eradicated bilateral metastatic disease. The mortality from bilateral neck dissection would most likely exceed the number of patients cured by bilateral neck dissection. There are no available statistics to prove this contention, but the mortality from bilateral dissection of the neck cannot be ignored. If the disease from the extended lesion has not been deposited in the second side of the neck, there is no need for the bilateral dissection, and if it has so metastasized, the mortality percentages from the surgical procedure will surely surpass the percentage of cure.

The percentage of cure of carcinoma of the base of the tongue is extremely small, when the metastatic cervical nodes are subjected to surgical excision. This holds even though in many cases the cells of the growth are well differentiated. Many cancers in this region are so graded. The poor results of lesions of the base of the tongue are due to the midline position of many of these growths, with consequent metastases to both sides of the neck as well as to the mediastinal lymph nodes.

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the tongue where 20.4 per cent of a representative group recently analyzed were either transitional cell carcinoma or lympho-epithelioma. This type of cell as well as the central location of the lesion accounts in some measure for the poor results in the surgical treatment of metastatic nodes from carcinoma of the base of the tongue because these types metastasize early and bilaterally at times giving rise to distant metastases in the mediastinum abdominal cavity and in bone.

TABLE I.—GRADE OF TUMOR IN NEARLY 400 CASES ANALYZED 1923-1931

Location of lesions	Grade of tumor			Transitional and lympho-epithelioma—%
	Grade 1 %	Grade 2 %	Grade 3 %	
Tip of tongue	25	57		
Dorsum of tongue	24	37	4	
Lateral border of tongue		74		
Base of tongue	4	66	9.2	20.4

It is not necessary to dwell long on the criteria for neck dissection as related to the gradation of malignancy of the oral tumor. Before the degrees of malignancy were understood, the very prompt and widespread recurrence, after neck dissection, of carcinoma in the operative wound was the source of considerable consternation. This manifestation usually occurs within a few months of the surgical procedure and is not confined to any one portion of the neck, but the growth invades the skin about the scar and often infiltrates the skin to the full extent of the operative flap. This type of infiltrative growth promptly ulcerates and because there is also recurrence in deeper regions of the neck, hemorrhage frequently occurs from early ulceration and erosion of blood vessels. Although the bleeding from the lesser vessels may be controlled by moderate pressure, the constantly associated infection increases the ulceration until there is massive necrosis of the tissues of the neck with hemorrhage from the larger blood vessels which cannot be controlled. The depletion of the patient by repeated bleeding from the erosion of even the smaller vessels decreases his resistance to bacterial infection, so that death intervenes, caused by infection as much as by carcinoma. This sequence of progressive disease is most common in the transitional cell type of carcinoma and lympho-epithelioma, and to a lesser extent in epidermoid carcinoma, grade 3. These first two types seldom occur in the lateral border of the tongue being much more frequent in the base of the tongue, the tonsil, and the

nasopharynx. The same sequence of recurrence—*infiltration ulceration with erosion of the cervical vessels*—may and does occur in the more adult types of carcinoma, when ill advised or inadequate surgery is done.

*Limitation of cervical metastases.* The fourth in the group of criteria for neck dissection in oral carcinoma will necessarily be considered under two headings, because the indication and contra-indication are not antitheses as in the other criteria, which were discussed together. Therefore, the lesions of the lateral border of the tongue will be used for the indications, and this same group together with a larger group of all oral lesions previously reported will be used to explain the contra-indications for neck dissection.

The condition of the cervical region is classified, irrespective of the primary lesion, in 4 groups: (a) those with no metastatic nodes throughout the course of the disease (b) those who develop metastatic nodes, (c) those admitted with operable nodes and (d) those admitted with inoperable metastatic nodes.

TABLE II.—CERVICAL LYMPH NODES IN 335 CONSECUTIVE CASES OF CARCINOMA OF THE LATERAL BORDER OF THE TONGUE

	Cases
No nodes throughout	39
Developed nodes—operable	64
Developed nodes—inoperable	28
Admitted with operable nodes	49
Admitted with inoperable nodes	55
Total	335

The cases have been classified in Table II according to the criteria previously enumerated except in regard to the grade of the tumor. The futility of neck dissection in the more malignant types of cancer was not fully understood in 1931 the first year included in these statistics. At that time the classifications as to the operability were based solely on the technical operability of the cervical region. The gold tubes for the interstitial application of radon into the tumor mass had not been developed at that time. These were first used extensively in 1935. As gold tubes of radon were not used in earlier years and as underdage by external irradiation as we now understand dorage was the rule an occasional case was subjected to surgical removal of the nodes which would now be assigned to radiation therapy only. Otherwise the criteria have held throughout this group of 335 cases of cancer of the lateral border of the tongue.

In the group of 135 cases which had operable nodes on admission or developed nodes after

admission, almost equal numbers were subjected to surgery of the cervical region and to radiation treatment of the nodes. The surgical cases had microscopic proof of the metastases in all instances, but some of the irradiation cases lacked this proof. The others had an incisional or aspiration biopsy. It is not necessary to give the percentages here, because in all cases the clinical evidence seemed quite adequate. Practically all the failures gave unmistakable evidence of cervical metastases, often by fungation of the tumor. Assuming that all irradiation cases had metastatic carcinoma, even then the comparative figures should be conclusive in regard to the procedure to be followed.

Sixty-eight patients were treated by irradiation and in 45 cases a neck dissection was done. The cases for these methods were not at all times deliberately chosen. Occasionally some other disease contra-indicated radical surgery. During the latter few years a large proportion of cases purposely have been subjected to irradiation rather than surgery.

The neck dissection in practically all the surgical cases was a radical dissection. In the first year or two covered by the statistics, in an occasional case a lesser procedure was done—removal of tissue of one or two triangles of the neck. In only one case was a simple excision of nodes done. The external carotid artery was ligated for hemorrhage, and gold tubes were implanted in the wound. This case has been allotted necessarily to the surgically treated group.

Of the 68 patients with operable neck metastases subjected to irradiation, 5 remained free of disease for 5 or more years. Three of these had positive biopsies at the time of the surgical exposure for radon implantation. The diagnosis in the 2 other cases depended on clinical examination. The group so treated, therefore, had a 5 year survival of 7.4 per cent.

In the operable group in which a neck dissection was done, in 45 cases, 9 patients or 20 per cent are known to have survived free of disease for 5 years or more. In the total operable group there were 2 cases lost in 4 and 4½ years, both free of disease at the time, and both had had proved metastases in the cervical region. It is reasonable to assume that there would be no recurrence at such a late date. Though such an event might occur in lip carcinoma, it is not so in carcinoma of the tongue. There was one lost case at 4½ years in the surgically treated and in the radiation treated group. If these cases were added to their respective groups, the percentage of the operable and irradiated group is 8.8 per cent and of the surgically

treated group it is 22.2 per cent. These percentage figures show considerable difference in the results of irradiation and surgery in the operable group. To get the proper estimate, these figures should be compared with each other. In doing so, it is learned that the surgical cases showed a better result by more than 200 per cent, even though there were included in the radiation group 2 cases that were not proved to have metastatic carcinoma microscopically, although the clinical evidence seemed sufficient to classify the nodes as metastatic nodes. If the non-proved cases were deleted from the statistics, the percentage of cured cases in the irradiation group would be 5.9 per cent whereas the surgical group would remain the same—22.2 per cent. These latter two percentages include the 4 and 4½ year cases. The question might be asked here why the non-proved cases were deleted from the well cases and not deleted from the failures. In the latter group there was no doubt about the presence of disease in the cervical region. The nodes progressed to a mass of cancerous nodes and often fungated through the skin. There is no difficulty in differentiating an advanced metastatic mass from inflammatory nodes in the late stages of metastases in the cervical region.

It might be maintained by the proponents of irradiation that the radiation treatment of the earlier cases was not as good as during the later years. That is granted. But because of the less efficacious irradiation by the roentgen-ray and glass seeds of radon in the first years of these statistics, some doubtful cases were subjected to surgery. These were included in the operable and operated upon group, but would now be allotted to irradiation. It is certain that these would more than compensate for the less efficacious irradiation of that period. The analysis of these two groups of cases by years has not shown any marked difference in the percentages. My first analysis from this point of view was done in 1933. Each year thereafter I have added one or more 5 year group of patients to my statistics. Up to the present time the percentage of cures by the two methods has not varied from year to year more than 2 per cent.

Although metastatic carcinoma of the neck can be cured by irradiation, as shown by the figures, the relative percentages of cures of the irradiated and the operated upon cases in the operable group leave no doubt as to the method to be employed. It may be that further experience with the more protracted external irradiation and the more accurately estimated dosage by interstitial radon may improve the result in the irradiation group.

This experience should be obtained not in the operable group but in the large number of inoperable cases, many of which are only slightly beyond operability. As these results improve then the irradiation method may be extended to the operable cases. Moreover there is always a small percentage of patients in the surgical group who refuse radical surgery. These may be conscientiously treated by irradiation.

If the mortality of neck dissection were high, then there might be some hesitation in its undertaking. In ascertaining the percentage mortality, to the above series of 45 operable and operated upon cases there must be added 9 cases in which neck dissection was done for supposed operable nodes, but microscopic examination proved the nodes to be inflammatory, therefore these cases are classified as having had no nodes throughout. In this total series of 54 neck dissections, there was one death a mortality rate of less than 2 per cent. This patient died of pneumonia, but he had a partial glossectomy at the same time the neck dissection was done. It is reasonable to attribute the pulmonary infection to glossectomy rather than neck dissection. Nevertheless, it is classified as a fatality following neck dissection.

*Absence of cervical metastases.* Because the contra-indication to neck dissection in this criterion is not simply the opposite of the indication for neck dissection it must be the subject for a distinct analysis.

If there are no nodes, a so called prophylactic neck dissection is not indicated. The statistics which lead to this contra-indication to dissection of the cervical region are taken from two sources—the present series of cases of carcinoma of the lateral border of the tongue and a larger group of carcinomas of all the regions of the mouth which was previously published in 1927. There is no reason to believe that there would be any change in the percentage of even larger groups. It is quite possible that there would be fewer advanced cases as evidenced by cervical metastases, because the laity is becoming more cancer conscious, seeking advice earlier and because present day treatment is more efficacious.

In this series of 345 cases of carcinoma of the lateral border of the tongue 39 or 4 per cent gave no evidence of regional lymph node involvement. Sixty-four patients omitted without metastatic nodes developed operable cancerous nodes during the period of observation and 3 developed inoperable nodes in the cervical region. The number of patients developing inoperable metastatic nodes would suggest a so called prophylactic neck dissection if the figures were accepted

without further analysis. However in some of the patients developing inoperable nodes, the metastases occurred bilaterally usually from advanced and extensive primary disease which was uncontrolled, and, therefore on that basis, contra-indicated surgery even before the metastases manifested themselves. A few had distant metastases at the same time as the cervical metastases appeared and radical surgery would have been of no avail. An appreciable number of cases were the highly malignant type and metastasized widely—this highly malignant type is not amenable to surgery. An occasional patient declined to return for observation for a time during which period an inoperable cervical metastasis occurred. In the last group some benefit might seem possible from a prophylactic neck dissection, but this possible benefit seems to have been nullified when the figures in Table II are examined. To attain any possible cure in this extremely limited group it would have necessitated a radical neck dissection in 280 patients, because surgery would have been done on the 139 cases with no metastatic nodes throughout the course of the disease in the 93 patients developing metastatic nodes, and in the 40 patients who were admitted to the hospital with the cervical region in an operable condition. A neck dissection would not have helped the 39 patients who had no metastatic nodes at any time nor would it have made any significant change in the result of those developing inoperable metastases. The routine neck dissection would mean this that 280 would have had a radical neck dissection whereas only 13 could reasonably have been expected to have derived any benefit. From this group were taken the 3 cases previously discussed under indications for surgery. Others developed inoperable nodes or refused surgery. One hundred thirty nine patients needlessly would have had a radical neck dissection. The mortality of this operation usually varies from 1 to 6 per cent. Fischel reported that, in a series of 42 cases of cancer of the lip with palpable nodes, only 14 of the nodes proved to be carcinomatous and in 13 cases in which there were no palpable nodes, microscopic examination showed the presence of cancer in the nodes in 2 cases. It is not reasonable to expect that the 5 year results would improve by such a percentage. The figures may be added the thought that 39 patients would have suffered the physical and mental discomfort of a major operation from which they obtained no benefit.

Previously published by me are the following figures for a much larger group of cases of all the oral lesions

TABLE III—CONDITION OF CERVICAL REGION  
IN SERIES OF CASES OF ORAL CARCINOMA—  
NECK NODES IN INTRA-ORAL CANCER

Site of primary lesion	Total cases	No nodes throughout—%	Operable nodes—%	Inoperable nodes—%	Developing nodes—%
Lip	271	77.5	10	4	8.5
Tongue	268	43.3	13	14.5	28.7
Floor of mouth	122	44.2	22.5	14.5	18.8
Inferior maxilla	84	65.5	10.7	11.9	11.9
Superior maxilla	62	72.6	9.7	3.2	14.5
Hard palate	31	77.4	6.4	9.7	6.4
Soft palate	34	58.8	11.8	11.8	17.7
Buccal mucosa	98	60.2	13.3	11.2	15.3
Tonsil	14	32.3	25	22.1	12.5
Antrum	65	70.8	10.8	13.5	17.4
Larynx intrinsic	105	69.5	5.7	15.2	3.8
Larynx extrinsic	99	44.4	11.1	41.4	3

These figures in Table III show the number and percentage of the cases in regard to the condition of the cervical region on admission for all the lesions of the oral cavity. From this table are derived the figures in Table IV.

It is noted in Table IV that the lesions of the different regions of the mouth show varying percentages of freedom from cervical metastases. Several factors are responsible for this fact. Among these factors may be mentioned the mobility of the part involved, the number of lymph channels draining the part and especially the degree of malignancy with the proportionate number of highly malignant lesions of the several regions of the mouth. Comparing the figures for carcinoma of the lateral border of the tongue (Table II) this difference is not as great as it at first seems to be, because in the larger series all the regions of the tongue were included. The base of the tongue is notably likely to show early cervical metastases, especially because of the frequency of the highly malignant type of growth. To some extent these figures vary, because in the larger groups (Table IV), the percentages were tabulated for a period of only 2 years, or less if death from uncontrolled primary lesion or intercurrent disease intervened, whereas in the series of cases of carcinoma of the lateral border of the tongue all patients were followed up to the time of death—for 5 or more years in the cured cases.

Analyzing the figures in Table IV in the same manner as in Table II the figures were important

TABLE IV—PATIENTS ADMITTED WITH NO  
CERVICAL METASTASES AND THE PERCENT-  
AGE FREE FROM METASTASES

Primary	Admitted without nodes	No nodes throughout	No nodes on entrance and no nodes throughout—%
Lip	233	270	90.1
Tongue	194	117	60.3
Floor of mouth	77	54	70.1
Inferior maxilla	65	55	84.6
Superior maxilla	54	45	83.3
Hard palate	6	24	92.3
Soft palate	26	20	77.0
Buccal mucosa	74	59	79.7
Tonsil	56	40	71.4
Antrum	54	46	85.2
Larynx intrinsic	77	73	94.8
Larynx extrinsic	47	43	91.6
Total	983	786	79.95

There were 1,363 consecutive cases in the group. Of these, 983 or 70 per cent were admitted without palpable metastatic nodes, 175 patients had operable nodes and 205 patients were admitted with inoperable nodes. If a neck dissection had been done on all patients except those in the inoperable group, there would have been 1,158 surgical operations on the cervical lymphatics, whereas only 372 patients had or developed operable nodes. The difference in these figures indicates the number of patients (786) on whom a major operation would have been done with little or no gain in the ultimate results.

*Perforation of the node capsule.* The criteria dealing with carcinoma involving or perforating the capsule of the lymph node cannot be discussed on a statistical basis, because these patients have been assigned for treatment by irradiation. This has been so for many years, because it was very promptly learned that surgery in this class of cases was futile. The rapidly growing and early metastasizing type involves the capsule early and surgery is contra-indicated because of the degree of malignancy. Other local metastases as well as distant deposits are probably present but not palpable at the time. The more differentiated types of carcinoma extend beyond the node capsule more slowly, but when the growth has so far progressed that it has invaded or perforated the capsule, the probability of eradicating the disease by surgery is most distant. Besides the possibility of more distant metastases and the uncontrol-

lability of the primary lesion, there is the added difficulty of estimating the limits of the metastatic disease. The carcinoma usually extended well beyond the palpable mass, often infiltrating an important blood vessel of the region or involving the periosteum of the mandible if the metastases was in the upper portion of the neck. Following the infiltration of the capsule, the carcinomatous nodes seem to necrose centrally very promptly because of the interference with the blood supply. The cavity may be very irregular in contour and may even involve the surrounding structure so that any surgical procedure will cause contamination of the normal tissue by viable cancer cells. Unsuspected involvement of the platysma muscle is often noted upon the exposure of such a node for radon implantation. The extent of the growth in this more advanced state of metastatic disease is impossible to ascertain. The sequence of events, following contamination of the operative field by viable cells from a node with a perforated capsule is the same as discussed under grade of tumor, namely recurrence, infiltration of skin and other structures of the cervical region followed by erosion and hemorrhage. The only variation is the greater rapidity of the progress, because of the diffuse contamination. The node capsule may be infiltrated and the node still be movable. Only after the cancer has perforated the capsule of the node does the mass become irregular in outline, merge with the surrounding tissue and become fixed. Therefore a metastatic node that is irregular in outline, merges with surrounding tissue, and is partially or completely fixed does not constitute a suitable condition for radical surgery.

**Extent of cervical metastases.** Bilateral cervical metastases contra indicate neck dissection. Contralateral involvement is practically the same contra indication, because with contralateral metastases the cervical region on the same side as the primary lesion up to certainly contains carcinoma but not in a palpable stage. The contralateral metastatic deposit may find more fertile soil, and therefore may reach a palpable stage more promptly than does the metastatic deposit on the same side as the primary lesion.

No statistics are available to show the futility of operating on bilateral and contralateral metastases, nor are there any such figures known. It may again be emphasized that published figures are the conglomerate type and include not only those cases with metastatic neck nodes but also those without metastases. These are of no value in deciding upon a procedure to be followed and in estimating the prognosis of an individual case.

The criteria dealing with bilateral metastases have been considered in that portion of the discussion relating to extension of the primary growth to the opposite side of the oral cavity and it need not be amplified here. Few surgeons now attempt the eradication of bilateral cervical metastases from oral carcinoma—except Ep.

**Distant metastases.** It is obvious that a distant metastasis is a contra indication for neck dissection. Such metastases occur in lungs, mediastinal nodes, liver, abdominal nodes, bones, and other less likely places. No known treatment can have sufficient influence on the disease in the more distant regions to indicate a radical neck dissection for concomitant cervical metastases.

**General condition of patient.** Because oral carcinoma is a disease of middle life and especially of the more aged, some consideration must be given to the life expectancy of a patient when treatment is planned. It is not possible to anticipate an acute pulmonary disease, nor some of the acute cardiac disorders, but it is possible to make some estimate of the kidney function, the condition of the blood vessels, and the state of the myocardium. Disease of the kidneys, blood vessels, and heart are the causes of many of the deaths in the aged. Unless there is a fair life expectancy for the patient, no radical surgery should be undertaken. The mental shock, the physical trauma, and the possible mortality should be considered in estimating the probable prognosis for each patient. This is a matter for clinical judgment and no rules can be formulated.

Based on the several possible manifestations, from the local lesion to the general condition of patient, the criteria may be expressed as follows:

#### NECK DISSECTION

Indicated	Contra Indicated
1 Primary lesion is controlled.	1 Primary lesion is uncontrolled.
2 Primary lesion is limited to one side of the oral cavity.	2 Primary lesion extends to or beyond the midline of the oral cavity.
3 Primary lesion is shown to be of highly differentiated cell type.	3 Primary lesion is shown to be of undifferentiated cell type.
4 Cervical metastases are present and limited to one group of nodes or nodes in its contiguous cervical triangles.	4 Metastatic nodes are present.
5 Capsule of nodes is not perforated by carcinoma.	5 Capsule of node is perforated by carcinoma.
6 Opposite side of neck is free of metastases.	6 Contralateral or bilateral cervical metastases are present.
7 No distant metastases are present.	7 Distant metastases are present.
8 Patient is in good general condition.	8 Patient is in poor general condition.

It should be obvious that for a case to be operable, all the indications for neck dissection must be present, and the presence of any manifestation mentioned in the contra-indications rules out a radical neck dissection.

The specific procedures to be followed in the treatment of the cervical region cannot be fully outlined. If the treatment is to be surgical only, the radical neck dissection is advocated. Some surgeons of experience seem to be satisfied with a suprahyoid dissection of the neck. It is my opinion that the radical neck dissection, removing the sternomastoid muscle and internal jugular vein, together with the bloc removal of the tissue of the cervical triangles, is the method of choice. In the irradiated cases, no exact procedure can be outlined. The available facilities for external and especially interstitial irradiation vary greatly in the many clinics. The radiological approach must depend on the available radium or radon and the type of applicators. These criteria are applicable for clinics in which competent surgery is done, and in which are located competent radiologists with adequate irradiation facilities.

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# AN EXTRAPERITONEAL METHOD OF REPAIRING A THIRD DEGREE PROLAPSE OF THE SIGMOID FOLLOWING A COLOSTOMY

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THE prolapse of a portion of the sigmoid following a colostomy may cause serious consequences. Although the prolapsed gut may be easily reduced, an operative repair is indicated if permanent restoration is desired. The main objection in repairing such a prolapse is the possible contamination of the peritoneum and the development of peritonitis. A procedure which completely excludes the prolapse from the peritoneal cavity is presented in this communication. Since the plastic repair is done extraperitoneally the danger of peritonitis is eliminated.

From the George W. Johnston and Georgetown Surgical Services of the Gallinger Municipal Hospital, Washington, D.C.

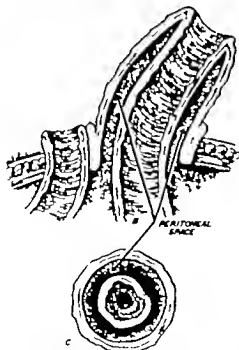


Fig. Schematic drawing showing the eversion of the prolapsed segment from fixed position at the end of the loop. Note the direct communication of the peritoneal cavity along the bowel with the general cavity.

Some degree of prolapse or eversion of the divided loop of bowel may follow any colostomy. It is more likely to occur in the double barrel type because of the size of the opening in the abdominal wall through which it protrudes. The size of the defect made in the abdominal wall in the performance of a colostomy is undoubtedly the most important factor in the prevention or the creation of a prolapse of the colostomy loop. Infection around the colostomy may break down the fasciason and weaken the stability of a newly formed artificial anus. A long redundant segment of bowel is more prone to prolapse than a short fixed segment. Prolonged increased intra-abdominal pressure as produced by straining in attempting to defecate, or in lifting a heavy weight, may cause the colostomy loop to become everted.

One may grade the extent of the prolapse of the colostomy loop into 3 degrees as is used for rectal prolapse. The first degree is an eversion of only the mucosa. The second degree is an eversion of the entire bowel wall but to a very short distance. The third degree is an eversion of several centimeters or inches of the bowel (Figs. 2 and 3). The degree of the prolapse depends upon the size of defect in the abdominal wall, the mobility of the sigmoid, and the intra-abdominal pressure.

Besides the presence of the protruding bowel the patient complains of local pain. There may be bleeding from the exposed mucosa, and, if not reduced, ulceration or gangrene may develop. The prolapsed loop may become so swollen that complete obstruction results. While it may be possible to reduce a third degree prolapse either by taxis or bed rest, it usually recurs. Furthermore there is a gradual increase in the size and extent of the prolapse so that surgical removal of the external segment is indicated.

During the past 3 years at the Gallinger Municipal Hospital, we have encountered 4 cases in which a third degree prolapse has occurred in one loop of a double barrel sigmoid colostomy. In 3 instances the lower segment became prolapsed and in 1 the upper segment.

The pathological anatomy of a prolapsed sigmoid loop is similar to that of an intussusception.



Fig 2 Third degree prolapse of lower segment of double barrel temporary sigmoid colostomy Colostomy for relief of stricture of rectum due to lymphopathia venereum

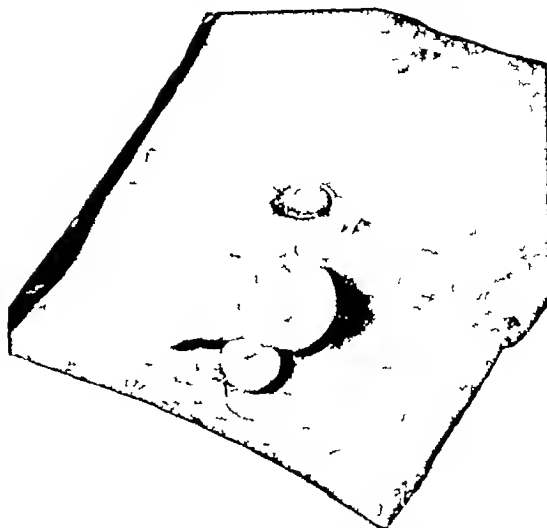


Fig 3 Third degree prolapse of upper segment of permanent type of colostomy Colostomy performed for relief of stricture of rectum due to lymphopathia venereum

The end of the sigmoid loop is firmly attached to the abdominal wall and remains fixed Therefore, the bowel protrudes by a process of eversion A cross section through the prolapse would reveal an outer tube with mucosa externally, a space

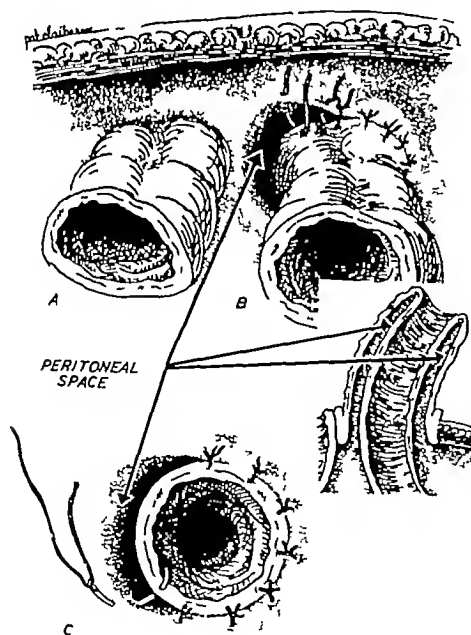


Fig 4 First stage of extraperitoneal repair from within abdomen A, Non prolapsing loop, B the prolapsing loop, showing closure of peritoneal space around fascial ring with No 00 chromic interrupted sutures, C, cross section of closure of space around fascial ring through which loop protrudes

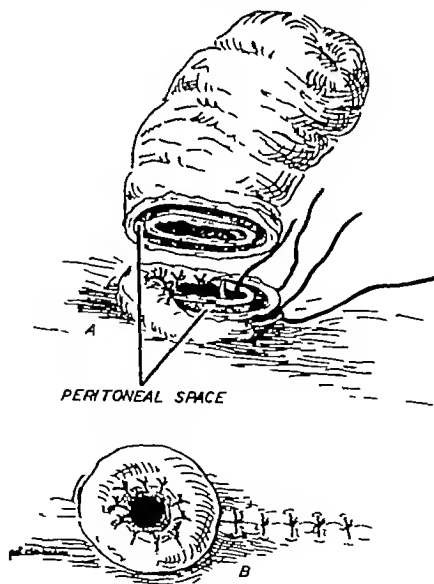


Fig 5 Second stage of repair A, Excision of prolapsed segment and closure of space, B, closure completed and defect in abdominal wall made smaller by the resuture of layers about the colostomy



communicating directly with the peritoneal cavity and an inner tube of bowel with the serosa external (Fig. 1). If one examines the colostomy from inside the abdomen, the double loop of colon will be seen extending through the abdominal wall. The opening in the wall is bounded by a hard fascial ring to which the parietal peritoneum is closely bound. In the case of a permanent colostomy the non prolapsed segment will be found to be firmly adherent to the abdominal wall and there will be no external extension of the peritoneum. In the Maydl double barrel type the non prolapsed segment will be firmly attached at all points except to the prolapsing segment. At this point it will be pulled a short distance through the opening along with the prolapsed loop. The prolapsed segment in the permanent colostomy may be entirely free as it passes through the opening in the abdominal wall. It may be attached along one side of the opening and free on the other. In this case the peritoneal extension will be limited to the free portion. In the Maydl type, of course the prolapsed segment will be attached to the non-prolapsed loop on one side. The manner of attachment of the loops and the degree of peritoneal extension through the opening cannot be accurately determined until the colostomy is exposed through an abdominal incision.

The danger of producing peritonitis by resection of the prolapsed loop is obvious since it does communicate with the peritoneal cavity. The gravity of this danger was illustrated in one of our cases. From an external examination we felt that we were dealing only with redundant mucosa. This was removed with a cautery, and a fatal peritonitis developed. In order to eliminate the possible contamination of the peritoneum, the following procedure has been used successfully in 3 cases.

The abdomen is prepared and draped in the usual manner with the colostomy washed off from the remainder of the operative field. A midline incision is then made at the level of the colostomy. In the case of a midline colostomy a left rectus incision should be used. When the abdomen is opened the inner loops of the colostomy are identi-

fied (Fig. 4). A finger is passed around the prolapsed loop and the extent of the defect and the limits of peritoneal extension are noted. Then a row of interrupted No. 00 chromic catgut sutures, completely encircling the prolapsed loop are passed from the serosa of the involved bowel to the adjacent parietal peritoneum of the fascial ring. This closes the peritoneal extension along the bowel loop and excludes the prolapsed portion from the general cavity. If the sigmoid is redundant it should be attached to the abdominal wall. A slit is made through the parietal peritoneum for several inches just distal to the colostomy opening. The redundant sigmoid is then sutured into this slit by interrupted sutures. The abdomen is now closed in layers.

The second stage is carried out 48 hours later in the following manner. The prolapsed loop is divided about 3 centimeters from the abdominal wall and all bleeders are ligated. The outer and inner bowel walls are then approximated with interrupted chromic No. 00 catgut sutures (Fig. 5). If the defect in the abdominal wall, through which the colostomy makes its exit, is too large it should be repaired at the same time. This is done by simply opening the old incision and reclosing the wall in layers making sure that a snug closure is obtained around the protruding loops.

#### SUMMARY AND CONCLUSION

One loop of a sigmoid colostomy may become prolapsed if the defect in the abdominal wall is too large. This defect may be due to improper closure of the abdominal wall about the colostomy or may be caused by separation of the incision following infection. Prolapse is more prone to occur in the double barrel than in the single barrel type of colostomy. Apparently the lower non-functioning loop prolapses more frequently than the upper functioning segment. The pathological anatomy is similar to that found in the presence of rectal prolapse. The danger of peritonitis following repair is obvious. A procedure which eliminates this danger by extraperitonealizing the prolapsed segment has been presented.

# GAS CYSTS OF THE INTESTINE

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**G**AS cysts of the intestine are a rare and interesting condition, first described in the American literature in 1908 by Finney. He encountered the lesion incidentally while operating for carcinoma of the pylorus and noted

"a curious, soft, multilocular cystic tumor, 15 centimeters long by 8 centimeters wide at its widest point, found attached to the free border of a loop of ileum about 1 foot above the ileocecal valve. No similar growths were observed elsewhere in the abdomen. From the peculiar cystic appearance of the mass, it was for a moment thought to be a beginning echinococcus cyst. On further examination, however, it was discovered that the cysts contained only gas. The cysts, of which there were a great many, were massed together like soap bubbles in a basin of suds, being irregular in shape on account of the pressure of the neighboring cysts. The cysts themselves varied in size from microscopic to as large as grapes. Each cyst seemed to have a thin, fibrous tissue wall of its own. Here and there hemorrhages could be seen in the fibrous tissue stroma. When the cyst walls were punctured, the air escaped with an audible hiss or pop, showing that it was under considerable pressure. The cystic growth was most prominent on the free border of the intestine, but completely surrounded the affected loop, extending here and there in scattered groups on both sides of the mesentery, for a distance of from 2 to 3 centimeters from its intestinal attachment. Some of the cysts were pedunculated. A single cyst or group of them might be attached by a single pedicle. The whole tumor mass was covered here and there by a thin, web like fibrous structure which suggested an old fibrinous peritoneal exudate that had become partially organized. There were no adhesions between the tumor and the surrounding structures."

Finney's description of the gross appearance of these cysts is quite typical. He and Professor William Welch, pathologist, believed that the growth was a distinct type of tumor, the cells of which have the faculty of secreting gas. At the present time this theory is not generally held, although the exact etiology of the condition is still unknown. Finney brought the literature on the subject up to date and gave a synopsis of the histories of 18 cases previously reported in foreign journals.

From the similarity of the gross and microscopical pathology dating from the first case reported by Bang in 1876, there is no doubt that the condition was known as a distinct entity even at that early date. It was also known, as was proved by secondary operation in Morris' case, that the cysts may undergo spontaneous disappearance. Nine months after an operation for stomach

trouble, during which he had found most of the jejunum and ileum covered with innumerable air-containing cysts, he had occasion to reopen the abdomen for obstruction and found to his surprise there was not a sign of a cyst to be seen on any part of the intestine.

A composite of the microscopical examinations of these cysts shows that they are of various sizes. They have, as a rule, a lining of endothelial cells with an outer wall of connective tissue. Within the dilated lymph spaces are numerous giant cells containing from 20 to 50 nuclei. Numerous dilated capillaries and small blood vessels are found in the fibrous tissue interspaces between the cysts. Most of the cysts are devoid of contents except air, and although they may occupy any layer of the intestinal wall, they are usually subserous.

The second report of an American case is by Turnure, of New York, in 1913. As in Finney's case, the condition was found incidentally while he was operating on a stomach lesion. Turnure gave a very complete description of his case, with pictures of the gross and microscopical appearance of the cysts. He observed (1) The gas found within the cysts was apparently atmospheric, (2) there is an absence of communication between the cysts, (3) there is an inflammatory and productive process between the cysts, resulting in the formation of connective tissue leading to the obliteration of certain cysts and, therefore, a kind of healing process, (4) absence of bacteria in most of the cysts.

He draws attention to the fact that the formation of small gas cysts in the intestine of animals (hogs) has been known for a long time. The disease, found in an otherwise healthy hog was first described by Maver in 1825. As to the origin of the condition found in animals, Schweitzer and Heydemann claimed that there is a certain amount of obstruction of the intestine, due to a catarrhal inflammation which causes accumulation of gas, and which under pressure is forced into the lymphatics through small openings in the mucosa, thus forming the cysts. Although Turnure discussed the pathogenesis of gas cysts from the following viewpoints, namely bacterial, mechanical, neoplastic, and chemical, he arrived at no definite conclusions concerning their origin.

Turnure cited 50 cases including his own, and gave abstracts of each case.

From the Jackson Clinic



Fig. Drawing of section of small intestine removed at autopsy. The appearance of the cysts in this case is similar to that in mine. (Courtesy of H. G. Sloan.)

Sloan in 1920 reported the third case in American literature. A picture of a section of the small intestine covered with the cysts is so similar to what I found in my own case that with Dr. Sloan's kind permission I am reproducing it here (Fig. 1). He discusses the etiology and decides that the condition is best explained by the mechanical theory.

My own case operated upon in January 1930 would be the fourth authentic American case.

In England Nich and Shattock reported typical cases in 1919 and concluded that the balance of evidence is slightly in favor of a mechanical causation i.e. an effusion of gas from the lumen of the alimentary canal through ulceration of the mucosa.

In 1923 they tabulated 85 authentic cases from all sources and noted that 50 to 60 per cent are accompanied by gastric or duodenal ulcer and 83 per cent have caused partial or complete obstruction.

Mills, in 1925, reports a case of his own and others. In 1 of the latter cases, a second operation was done 2 years later at which time the cysts had all disappeared. This fact corroborates Mori's case and my own.

In 1928 Silvestrone reported a case found at operation for perforated gastric ulcer. Approximately 13 months later it was necessary to reoperate on account of the gastric pathology and at that time there was no trace of the cysts found, the bowel being roughened and cicatrized.

Lamont, describing an additional case in 1928, believed that the gas is neither forced into nor formed in tissue spaces, but is formed in actual lymph channels. The anatomical arrangement of the lymphatics, which form a complicated series of plexuses, would be quite compatible with the tier-like arrangement of the cysts. Furthermore the histological appearances support this view. As to how the gas is produced, he is not ready at this stage to suggest more than that he believes the gas formation is purely a chemical reaction related to the absorption of the contents of a dilated stomach and bowel. Secondly to the gas production there is, he believes, a pathological process of perilymphangitis which results in the loculation leading to cyst formation.

Pybus reported a case in 1934. This case, like so many of the others, was encountered at operation for pyloric obstruction due to ulcer. It is interesting to note that x-ray examination showed air between the liver and diaphragm similar to Sloan's case, although no perforation was present. Both authors believed that this was of some diagnostic importance.

In 1929 Moore reported 4 cases in infants and states that up to this time only one previous case in an infant had been reported, and that by Maass.

Botsford and Krakower in 1938 described 6 additional cases in infants, bringing the total number up to date as 17. Englund's case which they include, is probably not a true pneumatosis of the bowel.

From the description of gas cysts in infants it would seem that grossly their appearance is similar to that found in the adult. Their location is in the mucous and submucous layers of the intestine whereas in the adult they are usually subserous. In 3 of the cases of Botsford and Krakower cysts were found in the mesenteric lymph glands, and in 1 the cisterna chyli and the proximal half of the thoracic duct were distended with gas. In most of the infants, diarrhea was a symptom and enteritis and mesenteric lymphadenitis was found at autopsy; erythema were giant cells found in and around the cysts.

#### CASE REPORT

Case No. 37, O. L. L. J. Farmer aged 53 years, first consulted me at the clinic in December, 1927 complaining of stomach trouble. For 5 years he had noted dull, gnawing pain in the pit of his stomach, which as present most of the time and as occasionally relieved by the taking of food. For several years he had omitted from one to three times daily and the contents consisted of undigested food particles, some of which had been taken several days previously. There had on occasion been some blood and mucus in the vomitus. His appetite as poor as his

constipated, and had lost some weight. All symptoms were more severe during the summer months. The family and past medical history were irrelevant, an appendectomy had been performed in 1905.

Physical examination showed a rather poorly nourished male, the heart and lungs were normal. Abdominal examination revealed marked tenderness at Mayo Robson's point. The liver, spleen, and kidneys were not palpable, and there was no evidence of hernias. Gall bladder x-ray films showed no abnormalities, a gastro intestinal series showed a very large stomach with several peristaltic waves, no duodenal cap. Diagnosis: pyloric obstruction, probably due to a duodenal ulcer.

Operation was advised but the patient demurred. I next saw him on January 26, 1920, 23 months later, when he was admitted to my service at the Madison General Hospital, referred by Dr M W Randall of Blue River, Wisconsin.

The history disclosed that 9 days previously a sudden, severe, epigastric pain had prostrated him. About an hour after the onset of the pain, vomiting began which had continued almost constantly. He had passed some flatus but had had no bowel movement since the onset.

Physical examination revealed his condition to be very grave. His abdomen was distended. His appearance was typical of an obstruction of several days' duration. An immediate laparotomy was performed. The small intestine was moderately distended and dusky red in color, and there was a volvulus present involving the ileum. Covering the greater portion of the intestine were innumerable cysts varying in size from a millet seed to almost as large as the end of one's thumb. In places they were found grouped together like a small bunch of grapes, they were also noted on the surface of the mesentery. Some were transparent, others presented a creamy white appearance. The cysts apparently were pneumatic, as they contained no fluid when opened.

Being unfamiliar with the condition at the time, I thought it was some type of cystic neoplasm. A specimen was removed and sent to Dr C H Bunting of the pathological department of the University of Wisconsin for examination. Dr Bunting recently re-examined the sections and submitted the following report: "The specimen consists of a series of cysts without obvious content. They are also without epithelial or demonstrable endothelial lining. Their walls consist of dense connective tissue which in most places is cell poor and fibrous, although in some regions fibroblasts are more numerous, and there are lymphocytic infiltrations. In one cyst several multinucleated, foreign body giant cells are flattened against the fibrous wall. In the angular tissue masses between the cysts there are some adipose tissue and a few arteries and veins of considerable size." A photomicrograph enlarged ten times accompanied his report and is reproduced here (Fig 2).

The volvulus was reduced and a simple enterostomy was performed. Due to the patient's extremely bad condition, no attempt was made to examine the stomach and duodenum.

Convalescence was slow but he made a satisfactory recovery. He was not seen by me again until September 5, 1923, 2½ years later, when he was brought to the Madison Methodist Hospital on account of abdominal pain of 24 hours' duration. The onset had been sudden and the pain severe. Needless to say, his condition was again very critical. He was vomiting, had a poor pulse, and the temperature was elevated. The abdomen was distended and rigid. The diagnosis was perforated gastric ulcer. Immediate operation was performed, and when the perito-



Fig 2 Photomicrograph of histological section through cysts of the mesentery

neum was opened considerable free gas escaped. The peritoneal cavity was filled with fluid and a fibrinous exudate was present throughout. There was a perforation 1 centimeter in diameter on the anterior wall of the stomach near the pylorus, partially covered by omentum, from which air and fluid were discharging, but no food particles were present. The remarkable thing was that, nowhere throughout the abdomen could be found any sign of the gas cysts which had been so numerous at the time of his previous operation for obstruction.

The perforation was excised and closed with a tag of omentum covering the sutures. The abdomen was washed out with several gallons of saline and closed. The patient rallied from the operation but had a very stormy convalescence. One month after operation he had a lysis of the abdominal wound, which was closed under local anesthesia. A month after this the symptoms from his pyloric obstruction at the site of perforation were so marked that the abdomen was reopened and an anterior gastro enterostomy was performed. This operation gave him immediate relief from his obstructive symptoms. At the time of discharge from the hospital he had a large incisional hernia.

In July, 1924, 6 months following discharge from the hospital, he reported to the clinic, complaining of pain in the left upper quadrant, thought to be due to the ventral hernia. Operation was advised but the patient refused.

Two months later he was again seen at the clinic, at which time he was still complaining of pain, locating it above the iliac crest on the left side. A colon x-ray film showed some distortion of the large bowel, which was thought to be due to adhesions. He was advised to have a repair of his ventral hernia but again refused.

In October, 1924, he decided, on account of almost constant pain in the upper left abdomen, to submit to opera-

tion which as performed by Dr. Reginald Jackson, on October 4, 1924. His operative record showed that there was a large central hernia. There were extensive adhesions around the stomach and coils of intestines. The gastro-enterostomy opening was adherent to the left upper posterior abdominal wall, just below the last rib. At this point was an area about 5 by 7 centimeters in diameter, was very densely indurated, and was found to be gastrojejunal ulcer which had perforated but was sealed off by attachment to the peritoneum. The mass was freed, the ulcer excised, and new gastro-enterostomy performed at the former site. The central hernia was repaired.

Pathological report by Dr. Huntington as follows: Section shows an ulcer with chronic inflammatory base in which there is no evidence of malignant growth. No mention as made of presence of any of the gas cysts previously described, so it is safe to assume there are none.

He was discharged from the hospital on November 2, 1924, in fair condition. He returned on March 2, 1925, still complaining of pain in left side of abdomen with considerable gas. The pain, however, was not of the burning character that he had before the removal of his gastrojejunal ulcer. There was no vomiting or hematemesis, no melena, bowels regular, no recurrence of hernia.

X-ray examination of the gastro-intestinal tract as reported as follows: Duodenal cap not seen, stomach adherent along the greater curvature to left parietes, 50 per cent gastric residual in 3 hours. Splenic colon appears to be involved in adhesions to stomach.

He has had seen at the clinic on August 7, 1925. His complaints were about the same as they are in his last visit 8 years previously except that left inguinal hernia had developed. The patient did not remain for further study. I saw a letter from his local physician stating that he asked duty on his farm, but that he had stricture of the esophagus which had to be dilated once or twice a year, the condition necessitating not doing most of the time. The patient is now 75 years old.

#### CONCLUSIONS

Pneumatosis of the bowel is a rather rare condition of unknown origin although at the present time the mechanical theory is generally held by the majority of authors. My own belief is similar to Lamont's, namely that gas gains entrance to the lymphatics at the site of an ulcer or a break in the mucosa of the stomach or bowel, and is then distributed along the lymphatics to points be-

tween the layers of the bowel walls in the form of cystic dilatations.

The condition is self limited and eventually undergoes a fibrous tissue healing. It therefore requires no treatment *per se* when found coincident with a gastric or intestinal lesion at operation.

Although much more prevalent in adults, gas cysts have been found at operation in children, the gas having a tendency to become entrapped in the lymphatics.

My own case operated upon in 1920, makes the fourth American case, and brings the total collected from all sources to 73.

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# INJURY TO THE FEMORAL ARTICULAR CARTILAGE BY THE MEDIAL MENISCUS

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**I**NJURIES to, and derangements of, the semilunar cartilages of the knee joint are of frequent occurrence. It is our desire at this time to describe a lesion of which we have been unable to find any previous description.

This lesion was first noted by one of us (A DeF Smith) in 1931 while doing an exploratory arthrotomy for an internal derangement of a knee. During the past 9 years, at the New York orthopaedic Dispensary and Hospital, it has been observed as the sole finding in 10 different patients. The last case is too recent to include in this communication, so that 9 are herewith reported. It has been noted in each instance during the course of an arthrotomy which was done because of suspected injury to the medial meniscus. The symptoms and signs are similar to those encountered in tears or gross displacements of the medial meniscus. Four different operators have independently noted the lesion while exploring the interior of a knee joint. These 9 cases disclosed only the pathology to be described, although in each a long medial incision was made, thus giving an adequate exposure of the joint. Other cases have been encountered but have been excluded from this report because they were complicated by additional lesions in the knee joint. The lesion is a well defined depression in the articular cartilage of the medial femoral condyle which corresponds in position and outline to the anterior portion of the medial meniscus. Converging upon this area is a pannus of vascular tissue which encroaches upon the femoral cartilage. We believe that this lesion is caused by an injury in which the meniscus is suddenly and forcibly pressed against the femoral articular cartilage with the knee in extension. Since in none of the cases was the meniscus torn or otherwise damaged, it is probable that the mechanism of this injury is different from that which commonly causes a tear of the meniscus.

Normally there is a slight impression on the articular surface of the medial femoral condyle which is made by the anterior border of the medial meniscus. This slight impression is termed

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Dr. King, Annie C. Kane fellow.

the medial groove. The medial groove normally receives the anterior border of the medial meniscus when the knee is extended. In the 9 cases reported, a sharply outlined depression was seen in the normally smooth surface of the articular cartilage overlying the medial groove of the medial femoral condyle. With the knee extended, the anterior portion of the medial meniscus fitted perfectly into this depression in the articular surface of the medial femoral condyle. A film of vascular tissue extended from the inner side of the medial femoral condyle down to the abnormal depression in the cartilage. The femoral articular cartilage was not lacerated or detached, and the underlying bone was not exposed. The articular cartilage covering the depressed area was thin and in some cases contained small areas of calcification.

This lesion does not have the appearance, usual location, or characteristics of osteochondritis dissecans, and is not to be confused with it. No loose bodies are present. The medial meniscus is not torn, and is seen to occupy its normal position. In 7 of our 9 cases, the operator described the medial meniscus as being more freely movable than normal, but in no case was there a gross displacement. The synovial membrane lining the medial aspect of the knee was moderately thickened and inflamed in 6 of the cases. Tissue sections revealed a chronic synovitis in 3 of these. Several knees presented a slight to moderate effusion at the time of operation. In all 9 cases the medial meniscus was removed, and the surgeon and pathologist could find no evidence of a tear.

## ANALYSIS OF NINE CASES BEING REPORTED

There were 4 males and 5 females. Their ages at operation ranged from 16 to 48 years, with an average of 24 years. All gave a definite history of injury. Eight sustained a twisting injury to the knee, and the ninth lost consciousness at the time of injury (automobile accident). None of the patients was certain about the position of his knee when it was injured. The time interval between the original injury and operation ranged from 1 month to 24 months, with an average of 9.5 months. One patient experienced periods of



Fig. 1. Lesion of articular cartilage of medial femoral condyle.

disability following minor twisting injuries to the knee and a second patient experienced 3 such periods of disability prior to operation. In the remainder the disability was continuous from the time of the injury to the operation. All cases developed an effusion immediately following injury. This was slight to marked and lasted from a few days to a month. Pain was complained of by all patients. This was described as being over the medial aspect of the joint line just behind the medial patellar border. Tenderness was elicited in all cases and corresponded to the site of pain in each instance. Prior to operation, 4 knees presented limitation of extension—limitations of 10, 0, 5 and 60 degrees, and 7 presented limitation of flexion—limitations of 5, 10, 15, 5, 40, 45, and 45 degrees. Only 1 of the 9 cases gave a history of transitory "locking" of the knee, and this was always reduced by the patient himself. All patients experienced a sensation of instability of the knee, which was noted chiefly when climbing or descending stairs. One patient, the same whose knee locked, experienced an actual giving way. Three patients noted catching, clicking, slipping or grating. All 9 patients were treated by exploratory arthrotomy and excision of the medial meniscus after conservative treatment in the form of bed rest, heat,

massage and a snug compression bandage had failed to relieve symptoms. All were relieved of the pain, tenderness, instability and other symptoms of which they complained before operation. A woman who was 48 years old, and whose motion was limited from 60 to 170 degrees, reported a slight residual limitation of flexion after operation. A girl 16 years of age had some pain in her knee during cold weather but had no limitation of motion or disability. Another patient had return of pain and tenderness on the inner side of the knee after spraining her ankle.

This lesion in all probability may have been noted by other operators, but in a survey of the voluminous literature dealing with medial meniscus injuries, we have come upon only the following observations. Henderson (13) stated that it is very difficult to estimate the amount of trauma that may be inflicted upon a joint surface by a crushing force exerted on attempted extension of the knee by a curled or crumpled up semilunar cartilage. Owing to its fibrocartilaginous nature, the semilunar cartilage may itself escape any serious damage and yet severely injure the cartilaginous articular surface. Bristow (2) noted erosion of articular cartilage with or without injury to or displacement of the semilunar cartilage in addition. Muller (7) noted that cartilaginous softening may take place at pressure points where menisci or other structures are situated, and that pressure from one structure may produce changes in the other. Chaklin found that in rare cases there was observed a combination of injury to the cartilage and to the medial meniscus. Darrach (6, 7) stated that the articular cartilage covering the femoral and tibial condyles and the under surface of the patella frequently is injured and softened. The milder lesions he considered to be often associated with an abnormal meniscus, fat tabs, or loose bodies. Morris believed that the pressure of a twisted or folded semilunar cartilage might cause erosion of the articular cartilage on the femoral condyle or the upper aspect of the tibia. Eames and Campbelle noted that in the condition described by the French as a *pincement de ménisque* (pinching of the meniscus) there is no rupture of the cartilage and no displacement of fragments, but simply a contusion with subsequent swelling of the semilunar cartilage.

The mechanism of injuries to, or displacements of the medial meniscus is an interesting story and various causative theories have been advanced by different authors. Sir Robert Jones called attention to the attachment of the medial meniscus along the whole of its convex margin

to the joint capsule and to the strong, somewhat fan-shaped internal lateral ligament. The anterior cornu is attenuated and its attachment to the tibia is never very strong and is often very slender. The function of the menisci is to assist the opposite lateral ligaments to resist lateral movements of the knee. They act as wedges between the tibia and femur and make the cruciate ligaments more tense. The cause of the injury to the medial meniscus he regarded as a strain thrown upon the internal lateral ligament while the knee is flexed and the femur rotated inward. Many observers (2) have noted that the coronary ligament attaching the medial meniscus to the tibia is approximately 6 millimeters in width, while that attaching the lateral meniscus is 10 millimeters in width. This, of course, limits the normal mobility of the medial meniscus, and predisposes it to pinching injuries. Galeazzi stated that fibrous bands connect the anterior cruciate ligament to the anterior horn of the medial meniscus. In semiflexion, rotation movements of the knee may cause excessive tension on the cruciate ligaments which is transmitted to the semilunar cartilages, and so may produce a variety of lesions. Cubbins and Conley noted that the semimembranosus tendon is firmly attached to the medial meniscus. If the leg is rotated outward, this tendon will be subject to greater tension and might press the medial meniscus deeper between the bones, so that it would be much more liable to be trapped upon sudden extension. Bernstein stated that the inner alar ligament as a rule is wider than the external and can be traced through the fat pad sending fibers which blend with it and descend to become incorporated or inserted with the coronary and transverse ligaments into the anterior cornu of the medial meniscus. Sudden contraction of the quadriceps tendon pulls the patella with a violent jerk, pulling the anterior cornu of the medial meniscus away from the region of safety by means of the internal alar ligament. Love believes that during the outward rotation of the femur on the tibia the associated movement of the more mobile lateral meniscus is transmitted by the transverse ligament to the anterior horn of the medial meniscus. Henderson (14) found that some fibers of the quadriceps are inserted rather low down on the inner side of the capsule. He felt that this prolongation, on attempted extension, might pull in such a manner as to disturb the normal contour of the medial meniscus, thus causing its anterior extremity to be caught between the femur and the tibia. He also believed (15) that there was such a condition as a hypermobile medial

meniscus which moves about enough to be pinched occasionally but not fractured. However, Surls and Osgood thought that when the quadriceps contracts it extends the joint and at the same time draws the capsule tense. The capsule transmits this pull to the menisci, and draws them up out of harm's way as the joint is extended, when the quadriceps relaxes, it allows the knee to flex and the menisci to slide centrally again.

Most observers (17) have felt that roentgenograms of these knees, which at operation present medial meniscus pathology alone, are negative save for some narrowing of the medial compartment of the joint space in long standing cases, and effusion in the more acute cases. In the anteroposterior view we have at times noted a thickening of the soft tissue capsular shadows overlying the medial aspect of the joint line. This may be seen not only in the lesion here described, but also may be seen with tears and displacements of the medial meniscus. McIlhenny noted a haziness or blurring about the internal articular portion of the tibial head in the anteroposterior roentgenogram.

#### CASE REPORTS

**CASE 1** F McR, No 133,216 Patient, a female, aged 20 years, fell from a ladder, 19 months prior to admission, and twisted her right knee. Marked effusion occurred and pain and tenderness were present over the medial aspect of the knee at the joint line. The knee felt insecure when she descended stairs. Symptoms were not relieved by conservative treatment, and on February 26, 1931, the right knee was explored. The lesion previously described was found, and medial meniscectomy was done. Examination on April 5, 1932, 14 months after operation, revealed full motion at the right knee. Only slight superficial tenderness about the operative scar was present. No instability was experienced. The knee ached slightly after prolonged walking, but the pain complained of before operation had been relieved.

**CASE 2** J S, No 157,023 Patient, a male, aged 20 years, had twisted right knee, 2 years prior to admission, while playing baseball. Effusion, pain, and tenderness subsided after 3 weeks of conservative treatment. Three subsequent similar attacks, brought on by minor traumas, occurred. Between attacks the left knee felt insecure and unstable, and flexion beyond 65 degrees was painful. Exploratory arthroscopy and medial meniscectomy were done on January 17, 1933. Examination on October 18, 1939, 6 years and 9 months after operation, revealed no tenderness or limitation of motion of the right knee which was stable and symptomless.

**CASE 3** B H, No 158,645 Patient a female, aged 18 years, wrenched left knee while tobogganing, 1 month prior to admission. Effusion, pain, tenderness, instability when climbing stairs and a sensation of "slipping" resulted. Motion at the left knee was limited from 165 to 40 degrees. On March 16, 1933, exploratory and medial meniscectomy were done. Examination on October 12, 1939, 6 years and 7 months after operation, showed complete range of motion of the left knee. There was no tenderness or instability, and normal function had resulted.



CASE 4. K. B. No. 67,431. Patient, female, aged 45 years, injured her left knee, 3 months prior to admission, by losing her balance as she stepped off a high train step. Effusion, pain, tenderness, and sense of insecurity resulted. Motion as limited from 70 to 80 degrees. Conservative treatment failed to give relief, and on May 2, 1934, exploratory arthroscopy and medial meniscectomy were done. Examination on October 5, 1935, 3 years and 5 months after operation, revealed few degrees limitation of flexion, but no other abnormality. All symptoms of disability of the left knee had been relieved.

CASE 5. F. W. No. 86,620. Patient, male, aged 3 years, injured his right knee 5 months prior to admission, in an automobile accident. Effusion, pain, tenderness and feeling of instability resulted. Motion at the right knee as limited from 30 degrees to 80 degrees. Exploratory arthroscopy and medial meniscectomy were done on October 5, 1935. Examination on October 3, 1936, 42 months after operation, revealed full motion at the right knee. No abnormal physical findings are present. Except for slight aching in damp weather, no symptoms were complained of. No instability or tenderness was present.

CASE 6. L. S. No. 85,371. Patient, female, aged 3 years, reached her left knee 1 year prior to admission, when thrown to floor by brother's explosion. Effusion, pain, tenderness, feeling of insecurity and "clicking" were not relieved by conservative therapy. Flexion was limited to 30 degrees by pain over the medial aspect of the knee. Exploratory arthroscopy and medial meniscectomy were done on April 9, 1937. Examination on October 5, 1939, 30 months after operation, revealed motion at the left knee to be complete. Examination as within normal limits, except for slight hypertrophy over the skin area supplied by the infrapatellar branch of the saphenous nerve. The only complaint as slight aching in damp weather. No "clicking" or instability as noted.

CASE 7. E. B. No. 140,610. Patient, female, aged 24 years, caught her heel on a step and reached her left knee 3 weeks prior to admission. Effusion, pain, tenderness, instability and "slipping" sensation resulted. Extension to 80 degrees caused pain and spasm. Exploratory arthroscopy and medial meniscectomy were done on June 20, 1935. Examination on October 5, 1936, 6 months after operation, revealed no tenderness, limitation of motion, or instability. Following fall in which she sprained her left ankle on January 1, 1940, she had some pain and tenderness on the outer side of her knee.

CASE 8. F. D. N. 4530. Patient, male, aged 4 years, twisted his left knee 1 year prior to admission. Effusion, pain, tenderness, instability and frequent attacks of transitory "locking" which are easily reduced by the patient, are not relieved by conservative treatment. Exploratory arthroscopy and medial meniscectomy were done on September 4, 1935. Examination on October 23, 1936, 5 months after operation, revealed full motion at the left knee. No instability, tenderness, or restriction of free motion as present. 75 degrees lateral relaxation, which had been present before operation, is still present. His only complaint as slight aching after prolonged standing, due probably to the lateral relaxation.

CASE 9. S. M. No. 2. Patient, female, aged 6 years, reached the left knee, 2 weeks prior to admission, and sustained effusion, pain, tenderness, and feeling of instability. Motion as limited from 70 to 75 degrees by pain and spasm. Exploratory arthroscopy and medial meniscectomy were done on May 2, 1936. Examination on October 5, 1936, 5 months after operation, disclosed no tenderness or limitation of motion of the left knee. On February 1, 1940, moderate degree of pain upon descending the stairs as complained of, although the pa-

tient played basketball. No other symptoms. Crepitus was present on full flexion of the knee.

#### SUMMARY AND CONCLUSIONS

In 10 patients who complained of pain, stiffness, and disability of the knee following an injury, a lesion consisting of a depression in the articular cartilage of the medial femoral condyle with a pannus of vascular tissue converging upon it, was found. Although the knee was explored through a long medial incision, no other pathological condition was found and the area of damage to the femoral articular cartilage corresponded with the position of the anterior end of the medial meniscus when the knee was extended, and we believe that it was caused by an indentation by the meniscus when the knee was forcibly extended. The theory that the depression in the cartilage is caused by trauma is supported by the fact that in all the cases a veil or pannus of vascular tissue converged from the inner side of the femoral condyle upon the indentation in the cartilage.

Treatment consisted in exploratory arthroscopy and medial meniscectomy. In none of our cases was diagnosis made before exploratory arthroscopy because the history signs, and symptoms were identical with those of medial meniscus tears. In 10 such cases patients have been so treated at the New York Orthopedic Dispensary and Hospital during the 9 year period 1931 to 1939 inclusive. Nine of these patients have been followed-up from 5 months to 6 years and 9 months after operation, with an average follow-up period of 3 years and 3 months. The results have been most satisfactory in that the signs and symptoms of disability complained of before operation have been completely relieved in 7 cases and greatly improved in 3 cases.

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# EDITORIALS

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## SURGERY Gynecology and Obstetrics

FRANKLIN H. MARTIN  
Founder and Managing Editor  
905 1935

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LOYAL DAVIS, EDITOR

*Associates*

SUMNER L. KOCHE

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NOVEMBER, 1940

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### UROLOGY IN CHILDREN

**A**MONG the many notable and outstanding contributions to American medicine the development of urology in children takes high rank. It can be said in all truth that nowhere else has this subject received such intensive study as in this country. This particular field has been greatly benefited by widespread and intensive study. Evidence of this fact is that our conception of urinary disorders in infancy and childhood has undergone a complete change. Lesions which formerly were regarded as relatively frequent are now found to be relatively rare whereas, other lesions which were considered to be rare have been demonstrated to be relatively common.

One of the pioneers in the development of urology in children was the late Edwin Beer. If not the first, he was among the first to use an electrically lighted instrument to examine these little patients. For this purpose he used the Hayes pharyngoscope and to this he later attached a device by means of which the

ureters could be catheterized. The great difficulty in the early days was that cystoscopes of small caliber were not available. With the development of better and smaller instruments, however, it is now possible to examine boys as young as 7 days of age with a plain examining cystoscope. The early prevailing impression that cystoscopic examinations should not be carried out in children because of the possible severe reactions, is a notion that has been practically dissipated as it is now a well recognized fact that children tolerate instrumentation far better than do adults.

As interest in the subject grew the necessity for following a definite routine in study was more generally appreciated. The value of a careful study of the past history and careful physical examination, urinalysis, bacteriological study of the urine, roentgen ray examinations of the genito-urinary tract, the use of the cystoscope and ureteral catheter, the shadowgraph catheter, retrograde pyelography and cystograms has become increasingly more and more appreciated. Recently the addition of intravenous urography to our armamentarium has definitely established the fact that these children can and should have the same benefits of modern urological study as do adults. In every properly conducted children's hospital today there is to be found a urological department well equipped and well manned.

The literature of not long ago contains numerous articles dealing with the subject of cystopyelitis and its treatment, and the long list of drugs recommended in its treatment is astounding. The very multiplicity of the therapeutic measures suggested and advised over the years, is proof positive that the de-



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The method of choice for reduction varies in the individual fracture with the age of the patient and to some extent with the technical ability of the surgeons. Certainly the surgeon should be adequately trained so that he can choose the technique best suited for the individual case. More difficult than reduction is retention of the fragments in position, or fixation.

Fixation can be accomplished by continuous traction and, in some cases, this is the method of choice. Fixation also can be accomplished by plaster-of-Paris cast. This requires an exact technique, one that will not permit interference with circulation. Pins or wires may be inserted in the fragments, above and below the fracture line, and these are incorporated in a plaster-of-Paris cast which gives a more exact fixation. Internal fixation by means of bone plates or nonelectrolytic metallic plates (vitallium) is a method of choice in certain types of cases and is an established method of treatment since the time of its great advocate, Sir Arbuthnot Lane.

The third great principle in the case of fractures is to re-establish normal function of the injured part. A technique of treatment that will permit carrying out normal function of the part and at the same time assure fixation of the fragments will be the technique of choice, as has been proved by the excellent work of Lorenz Böhler. This is in accordance with the Hunterian principle, which is that the power to regain function is a property of the patient's will and brain. There is a period, as M. David showed, in the time of healing when absolute rest is essential and movement is injurious. There is also a time in the healing of a fracture when movement is beneficial. Recently Mason and Allen demonstrated this with controlled experiments for healing of severed tendons. A similar experiment should be done for the healing of bones. When the

time has been established experimentally, variability in healing qualities such as those due to age and differences in the functional demand of the bones in the body must be taken into consideration. The fracture must show osseous union and normal use of the part must be restored.

With the discontinuation of fixation, after-treatment, as we commonly think of it, is initiated. In a dependent limb in which there is bony union, the removal of support would be followed by swelling. This swelling can be controlled by the use of an Unna paste boot, elastic bandage, periodic elevation of the limb, or all of these methods may be used in turn. Massage is of value. Light massage has a sedative effect, it decreases the pain and tends to decrease the swelling. It improves circulation of the lymph and blood of the part. Some effects of massage are obtained, as Mennell pointed out, by its effect on the reflex mechanism. The after-treatment also includes graduated and controlled exercises. Active movement is the exercise of choice. No one appreciates more the importance of voluntary effort as an exercise than the industrial surgeon. The best type of exercise is the carrying out of normal function. Since the structures have been weakened, the exercises must be directed so that they stay within the limits of the individual's capacity. Gradually, as the capacity increases, the exercises, too, can be increased.

In the case of a fracture of the calcaneus, for instance, reduction must be followed by fixation. Early weight-bearing and functional use prevent muscular atrophy, improve circulation, and stimulate formation of callus. Fixation results in a decrease in strength. Weakness of the foot leads to pes valgoplanus. This condition is counteracted by bringing the heel in valgus and the anterior part of the foot in pronation. Re-education of

## TREATMENT OF FRACTURES A SPECIAL PLEA FOR THE TEACHING OF PRINCIPLES

**M**ODERN treatment of fractures presupposes a knowledge of the structure and mechanism of the human body. The surgeon can only aid and abet the natural defensive and recuperative powers which are inherent in living tissue. As Hilton stated a surgeon has no power to repair directly any injury; his chief duty is to ascertain and remove those impediments which obstruct the reparative processes and restore the parts to their normal condition. He regarded physiological rest as the most important means of accomplishing this. The therapeutic value of physiological rest was never more emphatically advocated than by Hugh Owen Thomas, whose genius devised splints which permitted enforced uninterrupted and prolonged rest.

Recently I had occasion to conduct an examination which included questions on the principles of treatment of fractures. I found an impressive knowledge of technical detail of not only one but many methods for the treatment of a fracture. Unfortunately however the reasons for using certain procedures in the course of treatment were not known. I feel that there is a need for more emphasis particularly in teaching upon anatomical and physiological principles underlying the treatment of fractures.

The surgeon should know that it is his duty to assume apposition of the osseous fragments. The slogan splint them where they lie means that displacement of fragments may be prevented by splinting the fracture before moving the patient. Effusions of blood into the tissues and increase of tissue fluid in the region of the injury are normal reactions that make for swelling. Furthermore an irritation

of the afferent nerve occurs at the site of the injured part. This sets up a reflex spasm, which is nature's attempt to obtain rest. It is much simpler to reduce a fracture before this swelling and muscle spasm have occurred; therefore, the principle holds that a fracture should be reduced as early as possible after the injury.

When fragments are displaced the surgeon must appose the ends of the fractured bone. The displacement may be due to direct trauma, or usually to the contraction and spasm of the muscles. There may be interposition of soft parts between the bony fragments. Since reflex spasm occurs with movement between the fragments, anesthesia is essential in the relief of the spasm and an aid in the reduction of the fragments. Traction and manipulation as demonstrated by their most expert exponent, Sir Robert Jones, have proved an excellent method of reduction in certain types of fractures. Traction and countertraction are the most useful methods for correction of displacement. Mechanical traction by means of a machine such as a pulley and weights or by a spring, is more satisfactory than by muscular pull of an assistant since muscular fatigue makes constant, equal and even pull difficult. In this connection an excellent rule is to place the distal fragment in alignment with the proximal fragment. To relieve muscle tension, the articulations above and below the site of the fracture must be put in the midposition or in the neutral position. This semiflexed position approximates the muscle attachments and thus relieves the tension. Direct or skeletal traction is an efficient way of obtaining axis traction. With the extremity in the position of relaxation and axis traction properly applied, shortening and angulation are obviated and this also usually takes care of interposition of muscles. More important than exact reduction is proper alignment of the fragments.

The method of choice for reduction varies in the individual fracture with the age of the patient and to some extent with the technical ability of the surgeons. Certainly the surgeon should be adequately trained so that he can choose the technique best suited for the individual case. More difficult than reduction is retention of the fragments in position, or fixation.

Fixation can be accomplished by continuous traction and, in some cases, this is the method of choice. Fixation also can be accomplished by plaster-of-Paris cast. This requires an exact technique, one that will not permit interference with circulation. Pins or wires may be inserted in the fragments, above and below the fracture line, and these are incorporated in a plaster-of-Paris cast which gives a more exact fixation. Internal fixation by means of bone plates or nonelectrolytic metallic plates (vitallium) is a method of choice in certain types of cases and is an established method of treatment since the time of its great advocate, Sir Arbuthnot Lane.

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normal gait is then started. The amount of use gradually is increased until the individual carries out light duty. The patient continues with light duty exercises and physical therapy until normal capacity is re-established when he returns to full duty. Any technique in accordance with these principles will if it is executed accurately give the optimum result.

Treatment of fractures, therefore presupposes a thorough knowledge of the structure and mechanism of the human body and an intelligent application of the anatomical and physiological principles. Students should be taught why a method of treatment is recommended as well as the technique for executing such a method of treatment.

EMIL D. W. HAUSER.

# TEXTS AND DOCUMENTS

## THE FIRST ANESTHESIA RECORDS (CODMAN, CUSHING)

HENRY K BEECHER, M D, Boston, Massachusetts

WITH the rapid development of anesthesia in recent years, it is easy to lose sight of the fact that as the modern specialties go this one is old, with its origins in the first half of the nineteenth century. The introduction of anesthesia into the clinic altered the practice of medicine perhaps more than any other single advance, so it is of some interest to keep the historical account straight by recording the specific steps in the progression of the specialty when they can be identified, even though they be minor ones.

It has been said that record keeping, the description and charting of the patients' course during anesthesia and operation, began in 1915. Since detailed anesthesia charts in the files of the Massachusetts General Hospital antedate 1915 by more than 20 years, it is of interest to record the fact that many of the Massachusetts General Hospital records bear the dates of 1894 or 1895. By that time two types of charts had been devised for the purpose and were in use.

The later eminence of those who were concerned with this early record keeping adds to its interest. The details can be described by the letters of those who were responsible for the records. First, there is the letter from Dr. Codman to Dr. Harvey Cushing. This letter accompanied a collection of the early charts.

11th 9th 20  
27 Beacon Street  
Boston

Dear Harvey

Having nothing better to do lately I have been trying to put my effects into order again after the volcanic dislocation caused by the war and incidentally by the renting of our house.

Katie, after my departure dumped all the accumulations of years into one pile. So during this snowy week I have had old diaries, letters and

From the Anesthesia Service of the Massachusetts General Hospital

unpublished attempts at 'papers,' and mercifully put them in the wastebasket. There are many things which remind me of you and show the stimulus you were to me. I am sorry that age now prevents me from reacting to your enthusiasm, and that I have ceased to cultivate my mind enough to follow your soarings in Pityriasis realms.

"One of the things I cannot bear to dump in the wastebasket is a collection of ether charts which we made 30 years ago! In connection therewith I find a long unpublished paper on 'Etherization,' in which I described vividly *I think* but somewhat tediously the process as we then knew it. I must say I have never read anything better on the subject. I recall that the reason for not publishing it was, that I took it to 'Coll' Warren, who regarded it as too frank for the good of the hospital, for it described in detail the case which I lost in the A. R. because I was paying attention to some tomfoolery which you (who had come in from the theatre), were entertaining us with, while the poor devil was inhaling vomitus! I also spoke of the case which stopped breathing under ether and interested you in Brain Surgery.

"So I send you these charts to destroy with some solemnity for you and I are the only persons that give a ——— for them. Do they give less ether per hour now?"

[Signed]

Sincerely  
E. A. CODMAN "

"Peter Bent Brigham Hospital,  
Boston, Mass.  
February 10, 1920

"My dear Dr. Washburn

"I have just received the accompanying note [the preceding] from Dr. Codman with these old ether charts of the year 1895. So far as I am aware they represent the first attempt made anywhere to keep charts during anesthesia, and the story is as follows:

"When Dr. Codman and I having entered the hospital together, were 'Junior House Pupils' I believe was the official term or 'House Pups'

"Dr. C. 'man free' Dr. C. 'man free' Dr. C. 'man free'



Operation Card

Ward 27  
 Name Emma Smith  
 Age 22  
 Weight 122 R 98 6 R 28  
 Date Dec 17 1894  
 Drug not any  
 Recovery Room

Imitate Rectal Temp  
 Smelling Smelled Anus only a little  
 Remarks (Please make slash spaces intermittent full etc)  
 She had little or no color was quite restless then it was quite regular all the time. Her respiration at times was slightly.

Operation Cerebral Anesthesia  
 Date put on 1-13 PM  
 Total Anesthet 2 24 PM  
 Drugs given only 34 1/2  
 No my Cerebral to cause easy breathing that



Fig 2 The two sides of an anesthesia chart used by Dr E A Codman at an operation December 17, 1894

the unofficial one, we gave the anæsthesia, as is the custom I believe now, twenty-five years later

"I hesitate to recall what an awful business it was and how many fatalities there were

"My first giving of an anæsthetic was when, a third-year student, I was called down from the seats and sent in a little side room with a patient and an orderly and told to put the patient to sleep, for Dr ——— was to operate for the class. I knew nothing about the patient whatsoever, merely that a nurse came in and gave the patient a hypodermic injection. I proceeded as best I could under the orderly's directions, and in view of the repeated urgent calls for the patient from the amphitheatre it seemed to me an interminable time for the old man, who kept gagging, to go to sleep. We finally wheeled him in. I can vividly recall, even now, just how he looked and the feel of his bedraggled whiskers.<sup>1</sup> The operation was started and at this juncture there was a sudden great gush of fluid from the patient's mouth, most of which was inhaled, and he died.

"I stood aside, burning with chagrin and remorse. No one paid the slightest attention to me, though I supposed that I had killed the patient. The operation was completed in spite of the episode, as a demonstration to the class. I slunk out of the hospital, walked the streets of North Bos-

ton the rest of the afternoon, and in the evening went to the surgeon's house to ask if there was any possible way I could atone for the calamity to the man's family before I left the Medical School and went into some other business.

"To my perfect amazement I was told it was nothing at all, that I had nothing to do with the man's death, that he had a strangulated hernia and had been vomiting all night anyway, and that sort of thing happened frequently and I had better forget about it and go on with the Medical School. I went on with the Medical School but I have never forgotten about it.

"Now, to come back to these ether charts. Codman and I resolved that we would improve our technique of giving ether, which in those days in the large majority of cases meant crowding the patient to the second stage of anæsthesia as quickly as possible, and for the most part we used old sea sponges.

"In order to make a game of the task before us we made a wager of a dinner as to who could learn to give the best anæsthesia. We determined to let the test of satisfactory anæsthesia rest with the patient's behavior in the ward, and though I have forgotten just what was our scale of marking the cases, a perfect anæsthesia was supposed to be one in which the patient was sufficiently conscious to respond when left in the ward with the nurse and did not subsequently vomit. You

<sup>1</sup>Curiously enough it has been impossible to identify this patient in the hospital records.

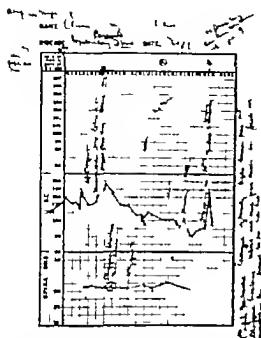


Fig. 3. The type of anesthesia chart preferred by Dr. Harvey Cushing and used by him in an operation July 7, 1903. The reverse side of the chart bears the notation in Dr. Cushing's writing: "Did not vomit. Not nauseated. Very quiet."

will recall that in those days we had no ether recovery room in general use, except for the Saturday clinics.

"I think we both became very much more skillful in our jobs than we otherwise would have become, owing to this competition, but it was particularly due, I think, to the detailed attention which we had to put upon the patient by the careful recording of the pulse rate throughout the operation.

Subsequently, on going abroad and getting interested in blood pressure, I discovered in use in Padua a simple recording instrument in Riva Rocci's clinic. On returning home I came to utilize this always during the course of my neurological operations so that the procedure might be as comparable as possible to the records taken upon a kymograph during an experiment in the laboratory. A much more elaborate ether chart was thereupon prepared, on which not only pulse rate and respiration but the systolic blood pressure was recorded.

'On Dr. Councilman's instigation a paper was read here in Boston January 9th, 1903, on the

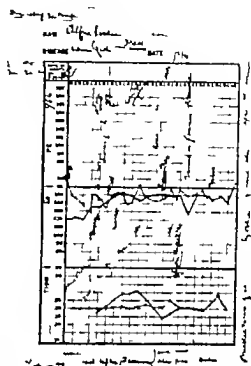


Fig. 4. Another chart kept by Dr. Harvey Cushing. The reverse side of the chart states in Dr. Cushing's writing:

Vomiting—Time and amount. None.  
Time to come out of ether—about 1 p.m.  
Bleeding—Free.  
When pulse comes down—  
At 1 p.m. asked for drink, as given cracked ice.  
Monitored continually until about 4 p.m.

subject of The Routine Determination of Arterial Tension in Operating Room and Clinic. This was the beginning, I think, of the general use of a blood pressure apparatus in hospital wards, whether medical or surgical, for though the principle was not new the old Gartner tonometer was most unsatisfactory because in cases of low blood pressure, the most important ones, it was utterly unreliable.

I mention this because it is of uninteresting, in view of the universal adoption subsequently of instruments to measure blood pressure. I recall that the Division of Surgery appointed committee to report on the subject. This report appeared March, 1904, *Bulletin of the Division of Surgery* and the final conclusion of this committee was as printed. "The adoption of blood pressure operations in surgical patients does not at present appear to be necessary as a routine

measure' I find I have written on my reprint the verse from Dr Holmes' Stethoscope Song

'Now such as hate new fangled toys  
Began to look extremely glum,  
They said that rattles were made for boys  
And vowed that his buzzing was all a hum'

"I have always felt that this was one of the most interesting illustrations on record, of the reaction against the introduction of an instrument of precision into clinical use. It is precisely what happened in the case of the thermometer, the stethoscope, the X-ray, indeed of the watch itself, if one may regard Floyer's first use of the pendulum for this purpose as a watch.

"I have been moved to write all this because of the memories which have crowded in owing to a sight of these old charts, and, simple as they are, you will see that Codman and I each got up our own type of chart. I am sorry that the final score is not given, nor do I remember who had to pay for the dinner. I am quite sure, however, that I did, for Codman usually managed to beat me in most things.

"I am sending this little bundle of things to you as it is a bit of ancient history, doubtless typical of many other bits of history that concern the succession of house officers who have rejoiced in their service at the Massachusetts General Hospital. It was undoubtedly a step toward improvement in what had been a very casual administration of a dangerous drug. We do much better with ether these days, but even so there remains much to learn.

"We are still, some of us, only too careless in its use, and such studies as Dr Cutler, and Dr Morton made during their term of residency at the M G H, pointing out the frequency of post-anæsthesia pulmonary complications, are but a further step in the direction of improving our technique in its administration. I still feel that one of the most important elements in the giving of an anæsthetic is to have the anæsthetist keep during its administration a detailed chart of pulse, respiration, and blood pressure. At the time of his notable address some years ago on Ether Day, Dr Keen, who took up this subject, intimated that too elaborate a record of this kind might take the administrator's mind from his primary job. I feel most emphatically that it keeps his mind on his job.

"Please put this in a corner of the Treadwell Library, where some day some young fellow may brush the dust from it and say 'Who were these fellows anyhow, and what is this "ether" they are talking about? Do you mean that people used

to be put to sleep by the inhalation of drugs in the 19th century?"

"Very sincerely yours,

[Signed] HARVEY CUSHING

"Dr F A Washburn, Supt.,  
Massachusetts General Hospital  
Boston, Massachusetts"

Last year letters were written to Dr Codman and to Dr Cushing asking permission to publish their records of 1894 and 1895 and letters of 1920. Four months before his death Dr Cushing wrote

"I see no harm in your calling attention to the matter, should you care to do so. Still, as he [Dr Codman] lost the wager, if my memory is correct, he may think otherwise."

Dr Codman wrote,

"I have not seen the exhibit [the anesthesia records] in the Treadwell Library but I shall take an early opportunity to look at it, and have no doubt that I will not have any objection to its publication.

"I do not wish to take any credit for starting the charts because of my recollection the keeping of these charts was suggested by my chief, Dr F B Harrington. I, of course, did the work but it was Doctor Harrington who thought that such a study would be valuable. If I recollect correctly, Doctor Cushing took up the work after I had finished my work as etherizer for I am quite sure that Doctor Cushing got his appointment about eight months later than I did, although we were in the same class in medical school."

A week later Dr Codman wrote another letter

"I have been to the Treadwell and seen the charts. Dr Cushing has a way of making things interesting and dramatic even at the expense of a little inaccuracy. I recall nothing about the dinner he speaks of, or of our determination to improve the technique of anæsthesia, but we were anxious to train *ourselves* to be good etherizers!"

"I took the opportunity to find the dates of our appointments as H O's. As I thought, I preceded him about 8 months and am quite sure that I had already begun the use of charts at the suggestion of Dr Harrington before H C appeared on the scene at all!"

In conclusion, these records of the Massachusetts General Hospital appear to be the first examples of record keeping in anesthesia. They were kept at the suggestion of Dr F B Harrington, first in 1894 by Dr E A Codman and later by Dr Harvey Cushing.

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

THE second edition of his book *The Diagnosis and Treatment of Diseases of the Peripheral Arteries* Dr. Samuel has covered all of the important arterial disturbances of the extremities. The book has been revised completely and lengthened by inclusion of such important conditions as peripheral arterial embolism, scalene syndrome, frostbite, ergotism, and aneurism. In the first part of the book the general symptomatology and methods of examination are discussed. This is followed by a detailed description of the etiology, signs and symptoms, and treatment of each of the conditions. Typical case reports and extensive bibliography follow each topic. The language is simple and the book is easy to read. The subject matter is based on the thorough experience in the peripheral circulatory clinics of New York.

As in the first edition a great deal of stress is placed on the treatment of the occlusive vascular diseases with intravenous hypertonic salt solution and it seems that not enough space has been allotted to other therapeutic measures, including surgery which has been found useful by other workers in the field. The reason for this, however, is probably the fact that the author has obtained such remarkably good results in the treatment of these cases by the former method. In over 500 cases of thrombo-angiitis obliterans he found it necessary to perform major amputations in only 3 cases.

A more detailed discussion of the underlying pathology and physiology would add greatly to clearer understanding of the various conditions discussed, especially in the case of the vasomotor disturbances and arteriovenous aneurisms. The closely related disturbances of the peripheral veins and lymphatics are not discussed, but on the whole the book is a worthwhile addition to the library of those acquainted with peripheral arterial disturbances.

SAMUEL PERLOW

THE fourth edition of *Minor Surgery* could be generously renewed here to incorporate herein the foreword by Allen Kanavel, Master of major surgery that he is, he recognized that "There is no greater field for good surgery than is presented by minor surgery. One cannot justly criticize the author's tendency to incorporate the general principles of major surgery in his volume, for

the dividing line is obscure and yielding as it should be. An incompetent minor surgeon contributes many cases to the major group. Conversely many major surgeons erroneously underestimate the scope of thorough working knowledge of the fundamentals presented so thoroughly in this volume. For the junior and senior medical year through hospital service and private or specialized practice the author provides such a readable up-to-date review of surgical therapy, well illustrated and embellished by many helpful hints born of his own broad experience, that one is attracted to its chapters with serious interest and wonder that such generous progress in the art and therapy of minor surgery has occurred since one has fled the field for major service. The work is rich in practical suggestions, seldom found in even our most elaborate surgical symposiums. For the beginner and the general practitioner Christopher's *Minor Surgery* is far more valuable than any shelf of books in major surgery. Its earnest disciple will conserve life and lessen disability and build for himself the lower but equally important round in the ladder of surgical success.

FRED W. BAZLEY

IN his book of over 600 pages, containing 303 illustrations, and in the preface the author of *The Foot and Ankle* states that he expected to describe everything that could happen to the foot and ankle but that he found that this would make two volumes. However the present book seems to have left out relatively little that is, so far as the mentioning of the various conditions is concerned, as there are 34 chapters and the table of contents covers 10 pages.

In book of this sort devoted to a specific portion of the body it is always a question in my mind, and undoubtedly also in the mind of the author, as to how far one should go into the fields of general medicine and surgery in dealing with the various conditions encountered. For instance, here 10 pages are devoted to gout and the dietary and medicinal treatment are described in detail.

In book on the foot and ankle one naturally expects a book in which there is rather extensive treatment on bones, one in which the anatomy and physiology of the foot are considered in great detail, and one which is largely devoted to bony deformities of the feet and which describes in minute detail systems of exercises and various forms of supports which are used in an effort to relieve painful feet. However

*THE DIAGNOSIS AND TREATMENT OF DISEASES OF THE PERIPHERAL ARTERIES* by Saul B. Samuel, A.M., M.D., ed. New York: Oxford University Press, 1949.

*MINOR SURGERY* by Frederick Christopher, S.B., M.D., F.R.C.S. With foreword by Allen B. Kanavel, M.D., F.R.C.S. 4th ed. Philadelphia and London: Saunders Co., 1949.

*THE FOOT AND ANKLE: THEIR ANATOMY, PHYSIOLOGY, DEFORMITIES, AND DISEASES* by Philip Lewis, M.D., F.R.C.S. Philadelphia: Lea & Febiger, 1949.

in this and in most other books on the subject, these subjects are not dealt with in great detail. The anatomy and physiology of the foot and ankle are covered in 17 pages and over half of this space is occupied by illustrations. The subject of shoes and the proper fitting of shoes is dealt with very briefly.

On the other hand, the author illustrates some very excellent felt supports for longitudinal and transverse arches and describes these in some detail, although he is sketchy about methods which are used by others.

Especially good are the illustrations of various types of operations for the correction of flat feet, of club feet, and of the deformities resulting from infantile paralysis. The author has taken considerable pains to obtain or reproduce the original drawings of various contributors to the literature on these subjects and is to be congratulated on reproducing some of the work of Dr Hoke. Congenital deformities are dealt with fairly well, but not to the degree and with the detail that is usual in a standard work on orthopedic surgery. The same is true of fractures of the foot and ankle.

Deformities of the toes and hallux valgus are covered in considerable detail. Tuberculosis, syphilis, gas gangrene, pyogenic infections, and fungus infections of the foot and ankle are dealt with briefly. A number of the standard operative procedures for feet paralyzed by poliomyelitis are described and the various deformities are illustrated. Also, the non-operative treatment of poliomyelitis, as well as the diagnosis, is taken up briefly. The section on spastic paralysis in which the Stoeffel operations are described is brief.

There is a relatively complete chapter on circulatory disturbances of the feet, including a short discussion on varicose veins and a description of the injection treatment. A 10 page chapter describes tumors and lists a large variety of neoplasms of the skin, bone, and intervening structures. The chapters on lesions of the skin and of the toe nails are especially good and practical.

There is an obvious intent to make the book encyclopedic in its scope and for this reason many subjects are of necessity dealt with very briefly. In the section on physical examination the author includes a record sheet which covers three closely packed pages, but apparently he never looks above his patients' knees. At the risk of being accused of "carrying coal to Newcastle," I suggest that the next edition include a chapter on the relation of static foot conditions to posture and body mechanics and that the patient be treated as a whole.

On the whole the book is a very valuable addition to the literature on the subject. It contains much of both theoretical and practical interest to any general surgeon or practitioner, as well as to orthopedic surgeons who treat conditions of the feet.

J ALBERT KEY

TO interest the practitioner in the early diagnosis and appropriate treatment of cancer is the pur-

pose of a small book<sup>1</sup> recently prepared by a committee representing the Massachusetts Medical Society and the American Society for the Control of Cancer. Its distribution to the practitioners through the state is made possible by a grant of funds from the United States Public Health Service through the Massachusetts Department of Public Health and the Massachusetts division of the Woman's Field Army. The State of Massachusetts has made rather extensive provision for aiding the medical profession in the early diagnosis and adequate treatment of cancer in the indigent population and this work is an accessory to such plans. It is deserving that the work should be dedicated to two illustrious men of Massachusetts, Robert B. Greenough and George H. Bigelow, who did so much to clarify the cancer problem in Massachusetts.

The work consists of a series of 44 articles ranging from 2 to 27 pages each, prepared by men interested in the subjects they present. It is not the purpose to give a detailed description of the disease as it may affect the sundry organs of the body but is intended as a guide for the practitioner in the diagnosis of early cancer and suggests the recognized form of treatment. It is interesting to note the large amount of concrete information that can be supplied in such limited space since the majority of the articles are limited to from 4 to 6 pages. The article of 10 pages on Hodgkin's disease and allied disorders by Jackson which appeared in the *New England Journal of Medicine* in 1939 is excellent, it is brief and yet supplies all that is known today relative to the diagnosis and treatment of these conditions.

Such a work is a step in the right direction in the process of stimulating the interest of the practitioner in early cancer diagnosis and adequate treatment.

JOHN A WOLFER

THE third edition of *The Compleat Pediatrician, Practical, Diagnostic, Therapeutic, and Preventive Pediatrics* by Wilburt C. Davison<sup>2</sup> has several revisions and improvements, yet retains its original compactness and well catalogued wealth of material. The rewriting has helped to clarify many sections, and also has corrected some typographical errors. The section on growth and development is a delightful compilation of facts which are difficult to obtain anywhere else without reading several volumes. This book is a valuable storehouse of facts to have close at hand.

L MARTIN HARDY

THE third edition of *Electrocardiography*<sup>3</sup> by Drs. Maher and Wosika is 334 pages long and contains 100 electrocardiograms fully interpreted, 42 schematic diagrams, and 5 roentgenograms. It

<sup>1</sup>CANCER: A MANUAL FOR PRACTITIONERS. The Committee on Publication. George W. Holmes, M.D., Chairman, Shields Warren, M.D., Ernest M. Daland, M.D., and Channing C. Simmons, M.D., Editor. Boston: Rumford Press, 1940.

<sup>2</sup>THE COMPLEAT PEDIATRICIAN: PRACTICAL, DIAGNOSTIC, THERAPEUTIC AND PREVENTIVE PEDIATRICS. 3d ed. By Wilburt C. Davison, M.A., D.Sc., M.D. Durham, N.C.: Duke University Press, 1940.

<sup>3</sup>ELECTROCARDIOGRAPHY. By Chauncey C. Maher, B.S., M.D., and Paul H. Wosika, M.D., M.S. 3d ed. Baltimore: The Williams & Wilkins Co., 1940.



is a clear and simple discussion of the elementary aspects of electrocardiography and includes all the more common problems that come up in this field of work. It can be read and understood by any physician as it presumes no previous knowledge of the subject. The diagrams and electrocardiograms are very clear so that the reader who might have been unfamiliar with electrocardiography could have no difficulty in understanding the analysis of the curves.

The reviewer however must call attention to some errors. On page 5, discussing atricular flutter the statement is made that accurate diagnosis is impossible without corroborative tracing. That is hardly true. With increased bed side experience. On page 36 appears the note that "the P-R interval varies in each lead, and is often longest in Lead II, where it is usually measured." The shortest P-R interval is the more accurate measurement of the conduction time. Figure xxx on page 39, could be just as well interpreted as delayed P-R interval as nodal rhythm with the evidence at hand. A tracing during carotid sinus pressure might have differentiated the two. Bundle branch block is too often long standing and static condition to be used as even confirmatory evidence of an acute myocardial infarction as has been done on page 75. Patients often have such curves but the acute episode may be biliary colic or pulmonary infarct, etc.

Finally it would seem that the size of the book could be diminished 30 pages (and the cost thereby decreased) by putting the electrocardiograms and the interpretation on the same page.

Despite all this, the general practitioner and student will find this book very useful in familiarizing himself with a subject that is increasing in importance.

SAMUEL A. LEVINE.

THE monograph on *Sulfanilamide, Sulfapyridine and Allied Compounds in 1 section* by Schnitzer which contains 72 pages with a bibliography of 702 references is reprinted from the *Oxford Lecture in Medicine*. The pharmacology, mode of action, and method of administration and dosage of sulfanilamide are followed by laboratory tests on the blood and urine. Various infections are discussed in detail in which sulfanilamide therapy is effective, doubtfully effective and ineffective. Similar points in the use of sulfapyridine are also described. Special emphasis is given to the use of sulfapyridine in the treatment of pneumonia. Literature on sulfathiazole therapy is too recent to have been included in this volume. The book is concluded with a description of the toxic manifestations of sulfonamide compounds and their treatment.

Detailed experimental and theoretical aspects of sulfonamide therapy have been largely omitted. In the foreword, Dr. Christian states that "the physician needs a book to turn to to find authoritative statements about the therapeutic utility of the sulfonamides, a book inclusive and comprehensive but not too long." Dr. Schnitzer has been highly successful in filling this need.

HENRY L. ALLEN.

*SULFANILAMIDE, SULFAPYRIDINE AND ALLIED COMPOUNDS IN 1 SECTION*. By MARION A. SCHNITZER, M.D. Edited by HENRY A. CHRISTIAN, M.D. M.D. Sc.D. (Biol.), F.A.C.P. THE J.B. LIPPINCOTT COMPANY. (Reprinted from Oxford Lecture-Less Medicine) New York, London, Toronto: Oxford University Press, 1942.

## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

**PATHOLOGICAL CONFERENCE RECORD, THE COOK COUNTY HOSPITAL.** By Dr. R. H. Jaffe. Edited by Chester C. Guy, M.D. Chicago: Cook County Hospital Internists' Alumni Association, 1940.

**CLINICAL UROLOGY.** By Oswald Swinney Lowrey, A.B. M.D. F.A.C.S. and Thomas Joseph Kirwin, M.A. M.S. M.D. F.A.C.S. Vol. 1. Baltimore: The Williams & Wilkins Co. 1940.

**PHYSIOLOGY OF THE FETAL ORIGIN AND EVOLUTION OF FUNCTION OF PLACENTA AND LOBE.** By William Frederick Windle. Philadelphia and London: W. B. Saunders Co. 1940.

**THE DOCTOR AND HIS PATIENTS, THE AMERICAN DOMESTIC SCIENCE AS VIEWED BY THE FAMOUS DOCTOR.** By Arthur E. Bertalan, M.D. New York and London: Harper & Brothers Publishers, 1940.

**BOYD GRANT SCIENCE IN DISEASE, I, II, AND III.** BY BOYD GRANT. By Fred H. Ayer, M.D. LL.D. Sc.D. F.A.C.S. F.I.C.S. Assisted by Alexander Kishner, M.D. B.Sc. New York and London: D. Appleton-Century Co. 1940.

**QUESTIONS IN GENERAL PRACTICE.** By J. P. Greenhill, B.S. M.D. F.A.C.S. Chicago: The Year Book Publishers, Inc. 1940.

**HOLT'S DISEASES OF INFANCY AND CHILDHOOD. A TEXT BOOK FOR THE USE OF STUDENTS AND PRACTITIONERS.** By the late L. Emmett Holt, M.D. and John Howard M. I. Revised by L. Emmett Holt, Jr., M.D. and Rustin M. M. Holt, M.D. 13th ed. New York and London: D. Appleton-Century Co. 1940.





*Georges Cuvier*

1769 1832

# SURGERY

## GYNECOLOGY AND OBSTETRICS

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### VENOGRAPHY, A CLINICAL STUDY

JOHN DOUGHERTY, M D , F A C S , and JOHN HOMANS, M D , Boston, Massachusetts

IN an effort to obtain a graphic delineation of the structural abnormality when venous thrombosis is or has been present this study was undertaken. It was felt that an opaque substance, injected into the venous system distal to the thrombus, should reveal an irregular defect to the roentgen ray as it flowed by the abnormality. Moreover, it was believed that a healed, canalized thrombus should leave discoverable traces if the opaque substance could be made to pass through the vein which had once harbored it.

The procedure is not a new one but has been used in recent years by workers both in this country and abroad. Earlier investigators were particularly concerned with a study of varicose veins of the extremities. In 1931, Sgalitzer and co-workers devised a technique for roentgen visualization of varicosities, by direct injection of radio opaque substances into the varicose vein. They were impressed by the extensive ramification of the abnormal veins as compared to the clinical findings. They used 40 per cent uroselectan or 20 per cent abrodil, and they reported one case of hemangioma with excellent delineation of the tumor. Shortly thereafter Barber made observations on blood flow in the extremities showing both normal and abnormal venous patterns. He concluded that the speed of the current carrying the opaque substance was

dependent on posture, state of rest or muscular activity, cardiac force and respiration, and that penetration from superficial to deep circulation occurred through anastomotic branches. The direction of blood flow in various, with special reference to the disposal of downward flowing blood by the communicating and deep veins, had previously been studied by McPheeters, but the lipiodol he used became separated into droplets and never demonstrated the outline of the veins.

An interesting report by Dos Santos (2) concerns the effort to delineate the vena cava several months after it had been injured during a nephrectomy. He says that the structure was clearly outlined and showed no defect. However, the plate accompanying his article is so faint that this cannot be clearly seen.

In recent years several observations have also been made on the use of venography in the field of venous thrombosis, particularly the manner in which this process affects the vessels of the lower extremities and adjacent portions of the body. The most comprehensive report is probably that of Dos Santos (3, 4). He considers most thoroughly the resistance to the rate of injection, the condition of venospasm, the irregular outline of the thrombosed veins, and the sclerosing effect of certain opaque solutions. He also mentions his experience with the rapid healing of varicose ulcers after venography, believing this

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1749 1822



Fig 2 Case of G T A venogram of a femoral vein recently thrombosed and now in process of canalization



Fig 3 Case of C C A femoral vein of slightly irregular outline having an abnormal valve It was later determined by operation that the external iliac vein had also been thrombosed and subsequently canalized Arrows point to abnormal valve and irregular outline of the femoral vein

the vessels is so faint that no positive conclusions can be drawn from their apparent size and contour. If a picture of these veins is required, more than 20 cubic centimeters of the solution must be used, and it must be allowed a longer interval to reach the great veins in question. Injection into a vessel of the thigh might be attempted but this was not done here.

*Venography for the arm.* Our experience with delineation of the venous systems in the upper extremities has been limited. However, with the procedure described we have been able to outline clearly the deep veins of the arm to and including the lateral portion of the subclavian vein. In each instance it was not necessary to tie a cannula into the vein used for the injection. An ordinary No. 21 venopuncture needle was found to suffice and the physiological saline was introduced by this means. It was found that injection into the median basilic vein (Gray) would carry the contrast solution into the brachial vein and

thence to the axillary and subclavian veins. The medial portion of the subclavian vein could not be visualized, when only 10 cubic centimeters of the contrast solution was used.

The 2 following cases are presented because of their unusual character and interesting venograms (Figs 2 and 3). These venograms and, for comparison, one showing a normal vein (Fig. 1) are reproduced.

A 17 year old school boy entered the hospital on April 5, 1939, complaining chiefly of diarrhea, cramping abdominal pain and general weakness. He had been well and active until 6 weeks before admission at which time he suffered a "head cold." Shortly thereafter diarrhea began and rapidly increased to as many as twelve watery stools a day. After the first few days these were blood streaked and occasionally even bright red. There was no abdominal tenderness or vomiting. A diagnosis of mucous colitis was made.

Eighty-seven days after admission he experienced a sudden severe pain in his left groin accompanied



Fig. Normal venogram showing deep vessels above and below the knee. Its communicating branches to the superficial circulation. Just above the junction of the popliteal and femoral there is normal air.

to be due to a direct therapeutic effect of the iodine and not to a possible sclerosing effect in the vessels. He expresses his confidence in abrodil an organic iodide preparation and considers such preparations as uroselectan B, tenebriol and picrofannus dangerous because of their tendency to sclerose. Other workers in this field have been Veal and McFetridge.

Our own work with venography has been principally concerned with chronic thrombosis of the lower extremities and its extension into the body. For injection we have used an iodine preparation under the trade name of diodrast (compound) in 50 per cent solution.

In the first few cases, 20 cubic centimeters of the 50 per cent diodrast solution were injected directly into the venous system by syringe and needle. This technique gave

fairly good results but was given up as unsatisfactory because it caused pain at the site of injection and because of the difficulty of introducing the needle into one of the tributaries of the greater or lesser saphenous trunk when the patient was in the horizontal position. It was difficult also to maneuver the patient into the position to be used in exposure to the roentgen ray if the needle had previously been inserted into the vein while the patient was erect. If the deep veins were to be studied it was found that the most satisfactory method was to cut down under procaine anesthesia, on the lesser saphenous vein behind the external malleolus. A No. 19 transfusion cannula was first tied into the vein and an infusion of physiological saline started. Such a set-up pictured in the accompanying sketch afforded many advantages since the patient's cooperation could then be secured to obtain any position desired. While the patient lay face down the leg being placed in full external rotation and moderate abduction, 20 cubic centimeters of the diodrast (compound) was injected into the rubber tubing of the infusion apparatus, which had previously been clamped between the flask and the needle. The rate of injection was about 1 cubic centimeter every 2 seconds. At the moment the injection was finished the film was exposed and the infusion was resumed. The amount of saline solution used before and after the injection was about 200 cubic centimeters. After the procedure the vein was tied off with a previously placed silk tie and the cannula was removed the skin being closed with a single stitch. In no case has this procedure caused unpleasant effects, related either to the contrast media or the technique.

Inasmuch as a clear view of the femoral vein at the groin without interposition of the femur was found very difficult to secure it seemed best to limit the exposure to the distal three fourths of the thigh and the upper fourth of the lower leg. This told very well the story of what was going on in the deep veins of the upper calf and in a considerable stretch of the femoral vein. For this purpose a film 4 by 17 inches was used. Views of the upper femoral and external iliac vein have been secured to be sure but the shadow of

Supplied in through the courtesy of the department of medical research, the Smithkline Chemical Co., Inc. The chemical composition of the compound is: grams of diodrast, 10; double-proportion, 10; sodium iodide, 10; disodium iodide, 10; grams of the sodium salt, 10; double-proportion, 10; sodium acid double-proportion.



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Fig. 3 Case of C C A femoral vein of slightly irregular outline having an abnormal valve. It was later determined by operation that the external iliac vein had also been thrombosed and subsequently canalized. Arrows point to abnormal valve and irregular outline of the femoral vein.

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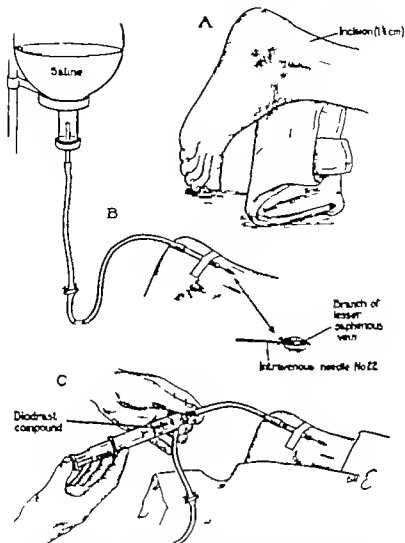


Fig. 4. The technique of making a venogram. A, The position of the foot and site of incision over the junction terminal of the lesser saphenous vein. B, The needle inserted and the saline connection made. C, The diodrast compound (30%) is injected into the rubber tube. Actually the sketch should have shown the foot turned up, not down, since the injection is made while the patient is supine and the thigh and leg rotated outwards.

by tenderness, coldness, and pallor of the whole leg. Arterial pulsations were absent even in the upper femoral artery. A surgical consultant (J. H.) felt that there had developed a deep femoral thrombosis and associated arterial spasm. A paravertebral lumbar procaine block, as made and about 6 hours later vigorous arterial pulsations returned. The very moderate edema of the entire leg, which now appeared, persisted for some days and as

thought it be consistent with diagnosis of femoral vein thrombosis. (Slightly enough there was no improvement in the signs and symptoms referable to the colitis.)

Thirt-six days after the onset of arterial spasm, venogram, as made of the left leg (Fig. 5) by the technique described. A tortuous outline of the injected fluid, as seen in the upper third of the femoral vein together with an unusual collateral cir-

culation These appearances were taken as evidence that thrombosis had, indeed, occupied the femoral vein, as previously believed, and that in the course of a little over 5 weeks had become fully canalized

A second case is reported to show how a venogram may support a clinical diagnosis

C C, a white farmer of 43 years, was well until 5 years before admission Following a blow upon the outer surface of his left leg, the limb had remained swollen and ecchymotic for several days Two weeks later, he suffered a sudden severe attack of pain in the right chest without radiation and without signs of an upper respiratory infection He was told that he had "phlebitis"—the left leg being swollen—and heart trouble On bed rest for a few weeks his leg returned nearly to its normal state and he was able to resume modified activity In the succeeding years he suffered numerous comparatively minor attacks of thoracic pain but no more objective trouble with the leg except slight swelling of the ankle on long standing Accompanying none of the attacks did he have evidence of upper respiratory infection, cough, or hemoptysis A few days' bed rest would relieve the pain and he would be able to resume his restricted activities

A rather severe attack in July, 1939, caused his local physician to refer him to Dr Paul D White, of Boston, with the question of "heart disease" Dr White felt that his was, rather, a case of repeated pulmonary infarction He was referred by Dr White to one of us (J H) for further study

His physical examination was negative with the exception of slight swelling of the left leg below the knee

Venographic studies were carried out on two occasions with pictorial evidence that the contour of the deep left femoral vein was irregular and that a deformed valve was present just above its junction with the popliteal (Fig 3)

One week after admission, one of us (J H) using spinal anesthesia and a left paramedian abdominal incision, explored the deep venous circulation in the pelvis There was definite evidence of perivenous inflammation and old thrombophlebitis The left external iliac vein was resected The fibrosed and tunnelled remnant of the original thrombus could plainly be observed Eleven days after operation, a third venogram was made, at which time even with the use of a tourniquet placed just above the knee, the solution could not be made to enter the deep circulation

The convalescence was good, the wound healed rapidly, the swelling disappeared from the leg and skin temperatures recorded by one of us (J H) showed that there was slight increase in warmth as compared to the right leg

#### RESULTS

Of the 15 instances in which venograms were made, there were, clinically, 6 normal

and 9 abnormal cases In none of these was there any reaction to the diodrast In the normal cases the solution passed freely into both the deep and superficial circulation In 1 or 2 of the earlier cases, however, the superficial circulation filled more readily than the deep, probably because the injection had been made directly into one of the small tributaries of the greater, rather than the lesser, saphe-nous system

An interesting phenomenon was noted in practically every abnormal case, namely, that there was rather pronounced resistance to the rate of injection Not only was more than the normal force required to cause the solution to enter the deep circulation but a longer period of time was required to complete the injection Whether this was due to venospasm or mechanical blocking of the circulation is difficult to say In a few instances, the roentgen results suggested spasm, but in others it was felt that the irregular outline of a thrombus could be seen or that the opaque substance failed to enter the vessel because it was completely blocked In several instances, light compression by rubber tubing was employed, usually above the knee, with the idea of forcing the diodrast-laden blood into the deep circulation This apparently had little effect, the direction of flow evidently depending on the existence of some intrinsic factor such as thrombosis or spasm of the vessel wall, and not upon such factors as limitation of expansion by periphlebitis or generalized edema of the tissues of the extremity

#### SUMMARY AND CONCLUSIONS

An experimental study in venography is presented in which 15 cases were used, of which 6 had clinically normal venous systems and 9 clinically abnormal systems

The study was limited to the lower extremities and the adjacent portions of the body and was principally concerned with thrombosis

A 50 per cent solution of an organic iodide, commercially known as diodrast (compound) was used in conjunction with an infusion set-up containing physiological saline solution

In none of the cases was there evidence of reaction

The literature both foreign and local is very briefly reviewed.

Two cases are reported with photographs of the venograms. The first was a case of acute femoro-iliac thrombophlebitis accompanied by arterial spasm. The second was a case of traumatic femoro-iliac thrombosis subsequently canalized and complicated by recurrent small embolisms. For comparison a normal venogram is presented.

We wish to express our appreciation to the Department of Roentgenology of the Peter Bent Brigham Hospital for their help in the preparation of this paper and especially to Dr. W. G. Miller of that department.

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# THE DIFFERENTIATION OF BENIGN FROM MALIGNANT POLYPOID BRONCHIAL TUMORS

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San Francisco, California

INTEREST in pulmonary neoplasms has increased since the introduction of the bronchoscope and the advent of low operative mortality for pulmonary resections (4, 9, 11, 31, 33). An important consideration in selecting and evaluating the results from treatment of these tumors is their pathological classification. Pulmonary neoplasms have been classified under single groups such as (1) bronchogenic carcinoma (Fried), (2) mixed tumors (Graham and Womach, 37), (3) reserve cell carcinoma (Ochsner). These classifications fail to separate the slowly growing, non-metastasizing, surgically resectable from the more rapidly growing, distantly metastasizing tumors, totally removable only in the earliest of stages. Some carcinomas such as the squamous cell epidermoid tumors may remain local for a long time, but in the late stages become widespread and no longer surgically resectable. Within such classifications are tumors not only of widely differing histological appearance but also of contrasting clinical characteristics. We believe that groups of pulmonary tumors can be discovered which differ sufficiently in microscopic appearance, growth potential, and clinical life history that they deserve to be definitely separated (Table I).

In other papers (6, 7, 18, 35), we have reviewed the development of bronchial adenoma as a clinical entity to be sharply distinguished from carcinoma. The purpose of this paper is to report our experience with the different clinical, pathological, and therapeutic features of adenoma and malignant polypoid bronchial tumors. The greater part of this paper will be largely devoted to a comparison of observed

features of two tumors arising from the bronchial epithelium, adenoma and carcinoma. This review is based on experiences with several hundred pulmonary tumors. From this group we have isolated 14 proved adenomas that have been carefully studied clinically and pathologically from postmortem, lobectomy, pneumonectomy, and bronchoscopic material. In addition, we have 6 patients whom we believe to have bronchial adenomas but in whom the diagnosis has not yet been completely proved. All of these cases throughout the years have been followed-up 100 per cent. Furthermore, some of the rarer, less understood connective tissue polypoid bronchial tumors proved difficult of early differentiation from both carcinoma and adenoma. We shall point out their differences of behavior and the pitfalls in their diagnosis.

Carcinomatous polypoid bronchial tumors present many contrasting clinical features in comparison with adenomas. The contrast is especially shown for age at onset of symptoms, sex incidence, and duration of symptoms (Table II).

The average age at onset for our 14 proved adenomas was 27 years, and 77 per cent occurred before the age of 40. These figures are in agreement with those reported by Gowar (1937), and Kramer and Som (1935). For carcinomas, the greatest age incidence occurred from 40 to 60 years, being 63 per cent according to Brunn (3, 1926), and only 10 per cent occurred between the ages of 20 and 40. In other large series (17, 34), the statistics are similar.

Sixty-four per cent of our histologically proved adenomas were females, and only 36 per cent were males. These statistics are similar to those published by Kramer and Som, and Peterson, who reported an incidence of 61 per cent in females—42 collected cases (32). Jackson and Konzelman's (23) cases show

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Read at the Third International Cancer Congress, Atlantic City, New Jersey, U.S.A.

TABLE I.—CLASSIFICATION OF POLYPOID BRONCHIAL TUMORS ACCORDING TO GROWTH POTENTIAL AND MICROSCOPIC APPEARANCE

Distantly metastasizing	
A	Carcinoma (epithelial)
	Adenocarcinoma
	Undifferentiated carcinoma
	Epidermoid carcinoma
B	Connective tissue
	Angio-endothelioma
	Fibrosarcoma
2. Locally metastasizing and/or infiltrating	
A	Epithelial
	Squamous cell carcinoma (trachea)
	Epidermoid carcinoma (squamous cell)
B	Connective tissue
	Fibrosarcoma
	Multiple myoma
	Fibromyxoma
3. Local without metastases	
A	Epithelial
	Adenoma
B	Connective tissue
	Fibroma
	Lipoma
	Angioma
	Chondroma
	Osteoma
	Single myoma

\*Fibromyxoma, fibrous local primary neoplasm and strongly

TABLE II.—COMPARISON OF AGE, SEX AND TOTAL DURATION OF SYMPTOMS OF CARCINOMA AND ADENOMA

	Adenoma 17 cases	Carcinoma 18 cases
Age at onset—		
Under 40 years	77	27
Over 40 years	3	85
Sex		
Female	64	62
Male	35	9
Duration of symptoms—		
More than		
1 year	92	1
5 years	75	
10 years	44	
15 years		
*1 case		
† From B. (1) and collected cases		
‡ Last 10 cases		

bronchial obstruction. If this obstruction is only partial, emphysema may be present in the distal segment of the lung and should be carefully looked for. Partial obstruction occurs early in the course of the disease so that wheezing or asthmatic manifestations may be the earliest symptom. When these tumors completely block the bronchus, they prevent aeration of the distal lung, and atelectasis results. Bronchial drainage is also interrupted resulting in inflammatory reactions associated with pneumonitis, bronchiectasis, lung abscess, empyema, and so-called 'drowned lung' (6).

Metastatic brain abscesses or emboli, and spinal cord lesions occur particularly from longstanding pulmonary suppuration and these should be distinguished from metastatic neoplasms. The occurrence of a lesion in the central nervous system associated with a primary cancer of the lung is almost always metastatic neoplasm. Such a lesion manifesting itself during the course of a bronchial adenoma is invariably due to inflammatory disease such as meningitis or brain abscess. It is important not to designate a primary pulmonary tumor as a cancer simply because central nervous system lesions have occurred during its course. In 2 patients who were presented to one of us the cause of death was primary pulmonary cancer inferred because both of them had died with central nervous system lesions. But a review of the original bronchoscopic biopsy material revealed the histology to be typical of adenoma and the

that 11 of their adenomas occurred in females in the only male they reported the diagnosis was doubtful as the biopsy specimen was lost.

An increasingly high incidence of carcinoma in males is now being observed. At least in part this increase is due to the failure of the earlier reports to differentiate adenoma from carcinoma. In 1926 one of us (3) reported 75 per cent incidence in males. But a review of our last 100 cases of histologically proved carcinoma shows that 91 per cent occurred in males. Ochaner has a recent series with 95.5 per cent of his cases occurring in males.

The high incidence of primary pulmonary cancer in males now becomes an important diagnostic criterion. Whenever we have made a presumptive diagnosis of adenoma and the subsequent course has proved us to be wrong, the patients have all been men whereas when the presumptive diagnosis has been made in women, particularly under the age of 40 the supposition has usually been correct.

#### SYMPTOMS

*Bronchial obstruction* (Table III). Polypoid bronchial tumors of any type tend to produce

histories showed that the duration of symptoms was more than 13 years in one instance and 8 years in the other

In cancer, episodes of pulmonary suppuration are usually more continuous and progressive and are often the chief cause of a rapid and downhill course. In adenoma they are more intermittent and are separated by periods of good health. They may continue for as long as 20 years and ultimately be the cause of death.

*Pulmonary bleeding* This is a symptom common to both types of tumor (36), and it has occurred in all of our adenomas. In adenomas, it usually occurs suddenly, becomes more copious, and stops more abruptly. It is more often the cardinal symptom. It can be alarming, requiring transfusion. In women, pulmonary bleeding is frequently associated with the menstrual period. It seems likely that vicarious pulmonary bleeding may come from an unrecognized adenoma in some instances. The relation of pulmonary bleeding to the menstrual epoch and the high incidence in females suggests that bronchial adenoma may be influenced by circulating hormones. In carcinoma, the bleeding is more of a streaking, and copious hemorrhages are rare. Hemoptysis is an initial symptom of adenoma in about one quarter of the cases (4 in our 14), but it has been the cardinal symptom relatively early in about two-thirds of our cases (9 of 14). The hemoptysis in carcinoma occurs relatively later in the course of the illness, and usually is overshadowed by the cough, pulmonary infection, and general debility of the patient. The incidence is about 40 per cent (3).

#### CLINICAL COURSE

The clinical course of patients with pulmonary cancer changes progressively for the worse. Blood-borne metastases do not occur with adenoma, but they are common in cancer. The adrenal glands are frequently involved, and such metastases may be the cause of the extreme weakness accompanying the later stages, even Addison's syndrome may be present. Adverse changes in the general condition of patients with adenoma are temporary. The general appearance of the patient with adenoma is usually good. Ability

TABLE III — COMPARISON OF THORACIC CONDITIONS ACCOMPANYING BRONCHIAL ADENOMA AND CARCINOMA

	Adenoma	Carcinoma
Lung	Atelectasis "Drowned lung" Repeated pneumonia Chronic infections	"Drowned lung" Atelectasis Acute infections with abscess
Bronchi	Obstructions with asthmatoïd symptoms Bronchiectasis	Obstruction Infiltration of walls
Pleura	Empyema Persistent bronchopleural fistula	Serous and hemorrhagic fluid Metastases
Mediastinum	Displacement	Metastases to lymph nodes Obstruction of vessels and esophagus Displacement Paralysis of phrenic and recurrent laryngeal nerves
Pericardium and heart	Displacement	Invasion
Central nervous system	Abscess Embolic phenomenon	Metastases

to perform moderate amounts of work is retained throughout a prolonged course, averaging 9 1/2 years until some complication arises (Tables I and IV). Intermittent bronchial obstruction with distal infection is the chief cause of exacerbation and remission in the patient with adenoma. Metastases and permanent bronchial obstruction, together with interference of mediastinal venous return or even esophageal derangements are the causes of the progressive downhill course in patients with carcinoma. The patient with cancer never seems to recover entirely from his first attack of bronchial obstruction, and he does not acquire an immunity to his pulmonary infection. Of our last 100 patients with pulmonary cancer, only 2 lived longer than 1 year after the onset. The patient with adenoma recovers quickly from her bronchial obstruction and generally appears to be in good health. She acquires an immunity to her pulmonary infection that is truly remarkable. This enables her to live as long as 25 years without succumbing. Thirty-six per cent (5 of 14) of our patients with adenomas lived 15 years or longer (Table IV). Some of these

TABLE IV—ADENOMA OF LONG DURATION WITHOUT METASTASES

Source	Duration (years)	Form	Treatment	Remarks
Kerns	11	Extra-endo-bronchial	Pneumectomy	Died. Lesion of lung by extra-bronchial portion
Kramer and Sam	30	Extra-endo-bronchial	Local removal of extra-bronchial portion	Tumor size of grape fruit. Died
Kramer and Sam	30	Extra-endo-bronchial	No treatment of extra-bronchial portion	Died after empyema
4. Jackson		Endo-bronchial	Local removal	
5. Jackson	30	Endo-bronchial	Local removal	N. metastases.
Jackson	15	Endo-bronchial	Local removal	Inflammatory condition of lung not given
Marick	30	Endo-bronchial	Local removal	Presence of extra-bronchial tumor not recognized
8. Author (I. K.)	41	Endo-extra-bronchial	None	Died of pulmonary suppuration. Tumor grape fruit size. Prominent atrophy right upper lobe
Author (A. B.—Case 1)	71	Endo-portal, extra-bronchial suspected	Local removal (pneumectomy advised)	Living and working, with mild symptoms of pulmonary suppuration, years after bronchoscopic removal
10. Author (H. G.)	36	Endo-extra-bronchial	Repeal and x-ray therapy (radiotherapy advised)	Living, with mild pulmonary suppuration and hemoptysis. Extra-endo-bronchial tumor slowly enlarging despite x-ray therapy years ago
Author (B. L.)	14	Endo-extra-bronchial	X-ray therapy (pneumectomy)	Living and well years after pneumectomy. Nine years after x-ray therapy large tumor still present
Author (J. B.—Case 2)		Endo-bronchial (extra-bronchial suspected)	X-ray (later bronchoscopic removal)	Symptoms still present. Large unremoved extra-endo-bronchial tumor present years after x-ray therapy and bronchoscopic removal

cases have had marked pathology, such as cystic dilatation and destruction of the lung proper but have remained practically symptomless over long periods of time (Cases 1-2).

The clinical picture of cancer of the lung is more bizarre. This is related to the fact that cancer may appear in any part of the lung and so involve many different contiguous structures in the thorax. The clinical picture of adenoma is more uniform because it is located in a large bronchus, and therefore always involves the same structures (Fig. 1).

Cases of adenoma may be easy of diagnosis. The symptoms at times are so characteristic that a presumptive diagnosis can be made from them alone. Frequently however they masquerade as tuberculous or cancerous patients. Six of our adenomas were previously diagnosed cancer, 6 were diagnosed tuberculosis (4 of these spent many months or years in tuberculous sanatoria), 3 were diagnosed both tuberculosis and cancer and 2 pulmonary suppuration.

#### ROENTGENOLOGICAL EXAMINATION

Roentgenological examination is beyond doubt of the greatest value in the differentia-

tion of pulmonary tumors, and in no suspected case should it be omitted. But endobronchial position, hilar location, and distal suppuration prevent the actual visualization of both adenoma and carcinoma (Cases 1-3 and 3). The usual plain x-ray film cannot differentiate adenoma from carcinoma, since with many cases of carcinoma as with adenoma the alterations seen in the films are chiefly those of bronchial obstruction. This is especially true of polypoid forms of carcinoma. Early cancer and early adenoma may give no demonstrable x-ray signs, but one should be watchful for small localized areas of emphysema or atelectasis (25-32).

The recent addition of *tomography* (33) has come as a great diagnostic aid in the recognition of these tumors. In this paper we have space only to illustrate a very remarkable instance of this (Case 1—Fig. 6 and 7). The more general use of this method will probably help in the diagnosis of tumors that are not visible by bronchoscopy because of their location beyond the visual field of the bronchoscope and may also establish the presence of extra-bronchial portions of these tumors that have hitherto been impossible of diagnosis by

the ordinary x-ray methods. By the use of tomography, it may be possible to visualize certain carcinomas of the lung, and the method may be of great prognostic importance as to operability. Hitherto bronchoscopists have felt that adenomas were entirely endobronchial. Our own opinion did not uphold this contention, and now the tomogram may prove the correctness of this thesis. Tomography is such a new procedure that it is difficult to evaluate these films accurately. We feel that the interpretations of tomograms will have to be confirmed by postmortem, lobectomy, and pneumonectomy findings.

*Bronchography* with iodized oil is often of great aid in disclosing the presence of tumor masses not visible by bronchoscopy or x-ray (14). By serial selective technique accompanied by endobronchial probing (19), the nature of the bronchial tree distal to the endobronchial tumor may be demonstrated (18). The demonstration of bronchiectasis distal to a polypoid tumor (Figs 16 and 17) usually means adenoma or other slowly growing tumors since the more rapidly growing ones cause death before bronchiectasis can develop (Case 4). A dilatation of the bronchus at the site of the tumor is particularly characteristic and easy of demonstration with the use of lipiodol. At times this dilatation is so marked that it may simulate the filling of an abscess cavity in the bronchogram (Fig 2).

The *bronchoscopic* image of an adenoma is often sufficiently different to distinguish it from a cancer in the same location. The movable, soft, fleshy, vascular, pink or purplish polypoid mass is characteristic of adenoma (23). A fixed, ulcerated, pale yellow or gray, indurated even to the hardness of cartilage, less vascular, broadly attached, protruding tumor is the usual appearance of the endobronchial cancer. The carina is sharp although tilted to the side of the tumor when adenoma is present. Cancer usually produces a flattening of the carina, and a characteristic feeling of the "frozen" condition of the mediastinal structures is imparted to the bronchoscopist by the large extrabronchial infiltrating cancerous mass. On taking the biopsy specimen from adenoma, bleeding is copious and frequently alarming (Case 2), but re-

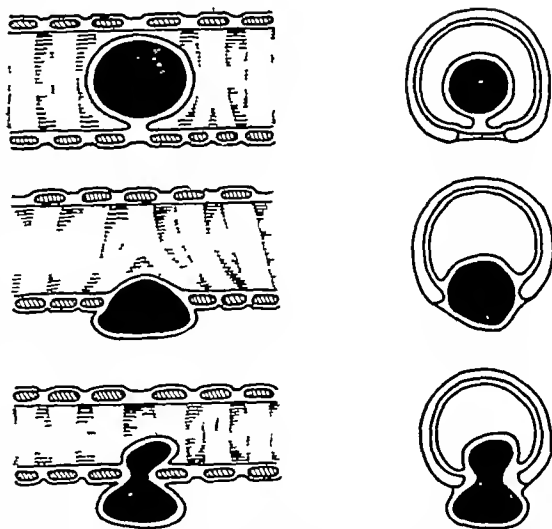


Fig 1 Three morphological types of bronchial adenoma. Top, type 1, endobronchial, middle, type 2, intramural, bottom, type 3, endobronchial. Types 2 and 3 can never be completely removed through the bronchoscope.

moval of a similar specimen from carcinoma produces no unexpected amount of hemorrhage. Bronchoscopic observations after original biopsy-taking from adenoma show healing of the wound, after the same procedure, no healing takes place in a polypoid cancer, but the tumor enlarges and the wound fills with exuberant new-growth. After local bronchoscopic removal of adenoma, a smooth mucous membrane regenerates over the former bronchial attachment, and the lumen may remain patent for years (Case 1). After a similar procedure for polypoid cancer, new tumor obstructing the bronchial lumen is formed again within one or two months, more or less.

*Bronchoscopic biopsies* may be misleading and inconclusive, because characteristic patterns are often not obtained (Fig 26). A superficial biopsy may show only squamous cells of the overlying metaplastic mucous membrane and so be erroneously called an epidermoid cancer when an adenoma hides below. Crushed biopsies of the epithelial cells often give the appearance of a wildly growing small cell cancer. Similarly, biopsy of a small celled carcinoma may be easily confused with adenoma. The bronchoscopic biopsy, therefore, should not be the sole foundation of our



judgment, nor the only criterion of future therapy

#### PATHOLOGICAL MANIFESTATIONS

The pathological manifestations are the basic propositions upon which one differentiates adenoma from polypoid carcinoma. Adenoma is a localized tumor which has three morphological types (Fig. 1). The first type is pedunculated and wholly *endobronchial*. The second type has a broader attachment and contains a large *intramural* portion. The third type is composed of an *endobronchial* and a contiguous larger *extrabronchial* portion (*extra endobronchial*). It thus has a dumbbell configuration. Thus it may be likened to an iceberg, which has a visible protruding and an invisible submerged portion. (Tomography may visualize this hitherto invisible portion.) The *endobronchial* portions have a tendency to be lobulated and as they grow point toward the trachea. The extension through the bronchial wall is accomplished by pressure atrophy and necrosis. Enlargement of the *endobronchial* tumor thins and dilates the bronchial wall. A limiting membrane surrounds these tumors. The *endobronchial* portion is covered by a thick, subepithelial, fibrous tissue capsule, and the mucous membrane often metaplastic, is not infiltrated by tumor. Even the *extrabronchial* capsule is well developed (Fig. 15). No such encapsulation occurs in carcinoma, for even though the *endobronchial* cancer be covered by intact mucous membrane, its *extrabronchial* portion infiltrates and invades, without delimitation, structures of the mediastinum or lung (Case 4). Although old adenomas may show *Durchwanderung* into the fibrous capsule displacement of the mucosa by tumor masses is characteristic of malignancy not found in adenoma (Fig. 20).

*Histologically* carcinoma presents various cell forms usually classified in different ways. We have used this simple classification: adenocarcinoma, undifferentiated, and epidermoid carcinoma. Mitoses large size marked variation in pattern and individual cells necrosis round cell infiltration coarse stroma lymph, blood vessel, and other tissue invasion and metastases are typical of cancer. Small,

uniform cells, arranged in regular patterns, alveolar or cylindromatous, are characteristic of adenoma (Fig. 13). A delicate reticular vascular stroma, with strands of hyalinized connective tissue separating the epithelial cell masses, give a unique appearance or alveolar patterns occur and, once observed, are rarely confused with carcinoma. Typical patterns are usually to be found in the postmortem or pulmonary resection specimens. These may produce mosaics under low power superficially resembling sections of fetal lung. Bone formation within the tumor is not uncommon (Fig. 14). Bronchoscopic specimens are likely to be distorted, crushed atypical, and difficult of diagnosis unless they are removed from the depth of the tumor so that characteristic patterns are obtained (Fig. 8).

#### TREATMENT

Expectant treatment without any direct treatment of the tumor itself leads to death within one year in approximately 95 per cent of our cases of cancer. Expectant treatment in adenoma (consisting of no treatment of the tumor *per se*) may be compatible with a moderately long though somewhat disabled, existence. Thus, one of our patients lived 18 years after drainage of an empyema and pulmonary abscess, the tumor being overlooked at the time. Another untreated patient (17) died with an empyema after symptoms of 30 years duration (Table IV No. 3).

Deep x-ray therapy for carcinoma of the lung has been disappointing. In a series of 53<sup>1</sup> cases in which patients were treated by Dr. Robert Stone, only 3 are alive after 1 year (Table II) and in 1 of these the *endobronchial* tumor is still present. The temporary good effects of x-ray therapy which were observed after radiation in some of our malignant tumors of the lung might have been due to the effects on round cell infiltration, distal atelectasis, bronchiectasis, and cellular exudate. The harmful effects were probably related to an exacerbation of the inflammatory reaction, with or without accentuation of the accompanying bronchial obstruction.

Several of our adenomas were treated with roentgen ray therapy by Dr. Robert Stone

<sup>1</sup>Excluded in our last case report.

but in no case did all the symptoms subside, and in every case in which bronchoscopic examination was performed afterwards the endobronchial portion was apparently unchanged (Table V). Apparent diminution of hemorrhages was observed in some cases. In 3 of our cases (Table IV, Cases 10, 11, 12), the tumor continued to grow slowly after x-ray therapy. Our experience with x-ray therapy of adenoma is at variance with the reports of Brock (2), but is in accord with the results reported by Peterson, who believes that x-ray therapy is of little or no benefit in the treatment of adenoma. Thus, there is still a great deal of doubt as to the results of x-ray therapy of both carcinoma and adenoma in the minds of men who have studied cases thoroughly.

Implantation of radon seeds into bronchial carcinoma (1,2,11) has been used, but intrabronchial radium seeds and bombs have been used more recently as a superior method. We have found intrabronchial radon of little value in a limited number of patients with cancer. For adenoma, Kernan, Jackson (23), Kramer and Som, Brock (1), and Gowar have reported favorable results with this method when combined with some form of bronchoscopic removal. The newer method of intrabronchial radiation described by Brock (2) has the advantage of maintaining bronchial drainage during the radiation therapy. This method seems worthy of further trial.

Bronchoscopic removal of carcinoma was advocated early in the historical use of the bronchoscope. This early enthusiasm was, no doubt, due to the failure to recognize that the isolated successfully treated cases had adenomas, not carcinomas. Ephraim in 1911, Jackson in 1917, and Orton in 1924 have reported such cases. It is doubtful that bronchoscopic removal has ever effected a cure in carcinoma of the lung. Three types of bronchoscopic removal have been used: fulguration, piecemeal removal, and snare removal. Adenoma responds readily to all three (Table V). Fulguration is the most dangerous, and of 3 patients so treated one of ours succumbed. The snare is applicable only to that type which has a narrow pedicle (Fig. 1). Endo-extra-bronchial or intramural forms cannot be removed *in toto* by any bronchoscopic method.

TABLE V — COMPARISON OF RESPONSE TO THERAPY OF ADENOMA AND CARCINOMA

	Adenoma	Carcinoma
X-ray	Questionable benefit No shrinkage of endobronchial tumor	Symptomatic temporary benefit
Intrabronchial radiation	Questionable benefit	Symptomatic temporary benefit
Bronchoscopic removal	Initial treatment of choice. Clinical improvement quick. Makes later elective pulmonary resection possible. Frequent lasting benefit. Late local recurrences after as long as 12 years.	Rare immediate but no lasting benefit
Pulmonary resection	Permanent cure in early or late cases. Lobectomy	Treatment of choice. Lasting benefit only in early or slowly growing ones. Pneumonectomy

Piecemeal removal of the endobronchial portion suffices to re-establish the bronchial lumen. Four of our patients have been treated in this way. Three still retained some demonstrable tumor in their last biopsies (Cases 1 and 3). Bronchoscopic removal has not produced increased growth or metastases. There is, however, a tendency for production of stenosis at the site of the endobronchial tumor (24). This, we believe, is usually associated with a recurrence of the tumor, and not with scarring alone. We believe that only in exceptional instances will the pedicle of the tumor be narrow enough so that complete removal may be produced via the bronchoscope. In the future, after several years, we can expect a recurrence of the tumor following bronchoscopic removals. It is for this reason that we believe bronchoscopic removal to be indicated chiefly to re-establish bronchial drainage as a preliminary treatment.

Early pulmonary resection, with removal of all the tumor and mediastinal lymph node dissection, is the treatment of choice for carcinoma (31), because residual viable cells are always a distinct hazard to the life of the patient with cancer. The resection is particularly successful in the localized squamous cell type.

of bronchial carcinoma (26) Graham has reported a successful pneumonectomy for such a cancer now 6 years without evidence of a recurrence. Nevertheless it must be admitted that distant metastases and local recurrences make the present end-results of pulmonary resection for cancer poor. On the other hand, bronchial adenoma forms approximately 25 per cent of the resectable bronchogenic neoplasms (Churchill, 10) although they represent only 6 (27) to 10 (10) per cent of microscopically proved bronchial new growths. If the patient survives the operative procedure, a permanent cure may be expected. Even though tumor is left in the hilar stump removal of the distal suppurating lung may bring about a satisfactory result. In at least one-half or 7 of our patients pulmonary resection was indicated for distal supuration with or without residual tumor. It was performed in 5 of these 7 cases. Adenomatous tissue was left behind in 2 of our cases, 1 after lobectomy and the other after pneumonectomy. One of these is completely well 13½ years after lobectomy. The other 1 year after pneumonectomy still has a small bronchial fistula. Whereas the failure to remove all carcinoma cells leads to early fatal recurrence, residual adenoma is compatible with many years of productive living.

The technique of lobectomy for adenoma is somewhat modified by the peculiarity of the condition encountered. These problems will be discussed in another paper now in preparation. Interesting data on other cases of the series, not included in this paper will be presented.

This discussion would not be complete without giving our experience with 2 other tumors of connective tissue origin, which gave us a great deal of trouble until the postmortem examination disclosed their true nature. These myxomatous and angiomatous tumors complicate the picture because they may have a long history simulating the course of a very slowly growing polypoid bronchial tumor and so easily be mistaken for adenomas. This mistake occurred and in both instances pulmonary resection was deferred until it was too late. In 1 case a male aged 55 years, diagnosis proved at postmortem examination to

be leiomyosarcoma with a large polypoid metastasis which was mistaken for the primary tumor (Fig. 23). In spite of the clinical course of 10 years' duration pulmonary resection was not advised until the patient's condition was so poor that no operation could be performed. In the other case, also a male, aged 19 years, the postmortem diagnosis was lymphangio-endotheliosarcoma. Pneumonectomy was performed after he was treated by bronchoscopic removals and x-ray over a period of 14 months. Death resulted 15 months after the pneumonectomy from metastases.

The surgical treatment of these tumors, when they are suspected should be prompt. Their growth potential and their malignancy is greater than that of adenoma therefore if a cure is possible lobectomy or pneumonectomy should not be delayed. In adenoma, on the other hand, delay would not be serious. Not enough cases have as yet been described in the literature to know either the life history of these connective tissue tumors or the prognosis following early surgical removal of them as compared with carcinoma.

Another group of patients we are observing have polypoid bronchial tumors, but no characteristic pattern in the bronchoscopic biopsy material (Case 7 Fig. 26). Exploratory thoracotomy will be necessary before adequate diagnosis can be made during life in this group. The course in these individuals has so far been benign, but we cannot be sure when infection, spread metastases, or accidents due to their location, will change a resectable into a non-resectable tumor. We are therefore advising earlier exploratory thoracotomy in those cases in which the diagnosis cannot be made in any other way.

At the 1939 meeting of the American Association for Thoracic Surgery Drs. Haight and Meyer reported a tumor the histological picture of which did not seem to belong to any of the groups herein mentioned. We feel that there may be other tumors discovered with which we are not yet familiar so that a complete classification cannot be made at this time. Because of the rarity of some groups of tumors (5, 8, 12) a definitive knowledge of them will be obtained only through co-

operative effort such as might be made through a chest tumor registry

CASE 1 J. B., aged 47, was first admitted to the University of California Hospital on March 8, 1928.

The onset occurred with cough, colds, and choked up sensations beginning in 1915 shortly following confinement. Soon afterward she noted wheezing localized to the upper right chest, which was brought on by exertion.

She was fairly well until 1922. At this time her wheezing and asthmatic symptoms increased. Her husband died of pulmonary tuberculosis that year, and, until 1928, she was suspected of having tuberculosis. Hysterectomy was performed in 1923 for uterine fibroids, and following this she had some increase of her periodic asthmatic symptoms. In 1926 her cough became more productive, and she had four pulmonary hemorrhages, with more than one cupful on two occasions. A diagnosis of pulmonary tuberculosis was made by her family doctor. He referred her to Dr. Shepherd, of San Jose, who after x-ray examination in 1928 (Fig. 3) made a presumptive diagnosis of cancer of the lung and sent her to Dr. Martin for bronchoscopy.

Dr. Martin made a bronchoscopic examination on March 8, 1928. A large, firm polypoid tumor in the right stem bronchus was seen. The entire presenting portion of the tumor was removed (Fig. 4). Histological diagnosis by Drs. Rusk and Ophüls of the bronchoscopic material was carcinoma (Fig. 8).

Shortly after the bronchoscopic removal of the tumor, she developed a severe pulmonary infection. X-ray therapy was instituted for several months in San Jose, and improvement followed (Dr. Shepherd).

She worked as a waitress throughout the following years, usually in very good health without dyspnea. There were recurring pulmonary infections, however, almost yearly from 1930 to 1935. During this time she was troubled with an annoying cough and considerable expectoration, and resorted to postural drainage. In 1935 she was given an autogenous vaccine, with marked improvement in cough and sputum so that she was much relieved until December, 1937. Then alarming hemorrhages with pulmonary infection recurred. For these she was hospitalized in December, 1937, June, 1939, October, 1939, and January, 1940. The last of these necessitated a stay of three weeks in the hospital. Excitement and exertion brought on hemorrhages.

She was not observed at the University of California Hospital from 1928 until February, 1940. At this time she reentered for study, having just recovered from her attack of "pneumonia" that had begun 3 weeks before.

At the present entry the patient notices that she is unable to lie on the affected (right) side. She also has found that voluntary pressure to the right chest wall with her hands produces soft, semi-solid sputum and brings relief of the dyspnea and feeling of fullness in the right chest. At times extension of the right shoulder facilitates the raising of sputum,

and she becomes conscious of the entrance of air into the lung after it has been emptied. She has a rather marked postural dyspnea when she lies on the affected side, which causes her to sleep on her left, or good, side. (This is unusual since most patients with bronchial obstruction favor the side of the obstructed lung.)

Physical examination revealed in general appearance a healthy, robust individual. She was without fever. There were signs of atelectasis of the right lung, with displacement of the mediastinum to the right. A marked inspiratory and expiratory wheeze could be heard over the right chest, which diminished or became absent when the patient lay on the left side.

Plain x-ray films taken February 15, 1940 (Fig. 5), disclosed a shrunken right lung with displacement of the heart and trachea into the right chest, and numerous whorls typical of cystic disease occupying the remains of the right lung (Fig. 5). No definite tumor could be seen in the plain x-ray films taken in different views and densities.

Tomographic studies made on February 4, 1940, at 8 centimeters from the back (Fig. 6) depict the outline of the displaced trachea, the carina, and the right stem bronchus. Almost filling the right stem bronchus is distinctly seen an endobronchial tumor with larger extrabronchial lobular extensions. In the lateral view, the endobronchial portion is well seen at a depth of 11 centimeters from the right side of the chest (Fig. 7).

Bronchoscopy was again performed on March 13, 1940. This disclosed a pinkish, soft, round polypoid tumor in the right stem bronchus almost completely obstructing it. The tumor extended to the level of the tip of the carina and was attached to the lateral side of the right stem bronchus. No secretions were seen although the suction tube could be passed along the mesial bronchial wall for a distance of 1 centimeter from the tip of the tumor. The bronchial tree was remarkably free from secretions, and normal in color. Bleeding was not produced. The patient refused to have a biopsy taken at this time.

This is our earliest case, and only after great difficulty did we succeed in obtaining a follow-up bronchoscopy 12 years after bronchoscopic removal. The early diagnosis of carcinoma at a time when adenomas were not recognized is understandable. The clinical course of this case proves that it was not malignant, as the duration was 25 years. The recurrence of the tumor has produced great changes in the entire structure of the right lung, until now we suspect it has been entirely converted into a fibrocystic mass. In spite of this, her episodes of fever are comparatively infrequent, and ordinarily she is able to carry on a rather strenuous occupation.

without discomfort. She looks well and hearty—so much so that she is resentful of any surgical intervention.

The specimen of tumor removed in 1928 by Dr. Martin is very characteristic of adenoma and the same pathologist now grants the diagnosis of adenoma.

This case also to a marked degree shows the ultimate effects on the lung parenchyma of the bronchial obstruction associated with the growth of these tumors.

The long growth history of this tumor as evidenced by the early bronchoscopic findings and x-ray films, shows that this tumor does not belong in the class of static vestigial remnants of fetal lung, but is a true slowly growing neoplasm, without any constitutional effects except those related to secondary involvement of the lung from bronchial obstruction.

**CASE 2** G. D. white female aged 43 was first admitted to the University of California Hospital on May 1939.

The onset of symptoms was in 1919 with non-productive cough and wheezing, followed by a series of chest colds. One year later, the first hemoptysis occurred consisting of a tablespoon of blood twice in one week. The diagnosis of pulmonary tuberculosis was made, and the patient was sent to sanatorium for the next 3 years, although the sputum was negative for tubercle bacilli. During the years 1933, 1934, and 1935 the patient was fairly well except for cough and clear sputum.

Pulmonary hemorrhages became the cardinal symptom in 1936. These occurred regularly at monthly intervals 5 to 7 days before each period usually one cup in amount. Sudden in onset, bright red appeared without warning, and continued for the next 2 years. They stopped for the following 9 months and then recurred more copious than before, now with dyspnea and wheezing.

X-ray films of the chest over 7½ years showed little change of the telecystic of the left lower lung (Figs. 9, 10, 11 and 12). The tumor itself was never visualized in any of the plain films.

On June 27 1939, Epidural distillation was performed, which showed complete obstruction of the left lower lobe bronchus, but the left upper lobe bronchus was patent.

Bronchoscopy at the University of California Hospital was performed on eight different occasions by Dr. Stephens, beginning May 1939, with the object of bronchoscopic removal of this tumor since there was so little evidence of atelectasis distal to it. The x-ray film showed very little atelectatic lung, and she had practically no episodes of fever or attacks suggestive of pulmonary suppuration with bronchial

obstruction. Also, we had no definite evidence either bronchoscopic or roentgenological, to show an extrabronchial portion of the tumor or to indicate its true size. Therefore it seemed, from the bronchoscopic observations alone, that this patient might readily be treated bronchoscopically. She remained in good state of health throughout the 6 months during which she was treated bronchoscopically.

At each bronchoscopic examination, polypoid, vascular pinkish tumor was seen obstructing the left stem bronchus at the level of the left upper lobe. On each attempt to remove it, whether with cautery or by biopsy forceps, alarming hemorrhages occurred which obstructed all visibility. However approximately 5 grams of tumor tissue were removed altogether. Yet tumor was always present obstructing the bronchus.

Finally it was decided to perform a pulmonary resection. A left lower lobectomy with individual ligation of vessels and high ligation of the pedicle was performed through posterolateral approach, by Dr. H. B. Stephens on November 19, 1939. Even though the bronchus was resected high, a small portion of tumor which remained attached to the proximal stump was removed separately together with its adjacent attached bronchial wall. Closure of the bronchial stump was made with silk interrupted sutures. The chest wall was closed without drainage.

The patient made an uneventful convalescence and was discharged on the seventeenth day after operation. She has remained well since then, a period of 3 months.

The pathological specimen of the left lower lobe (Fig. 13) showed markedly dilated left lower lobe bronchus, in which the great bulk of the adenoma lay. The bronchial cartilages showed pressure atrophy. The left lower lobe was atrophic, completely atelectatic, and reduced to a shell surrounding the tumor. Several cystic bronchiectatic pockets about 1 inch in diameter containing non-foul mucopus, were seen near the periphery of the lung. The tumor was 4 centimeters in diameter and as completely encapsulated. The capsule, as more fibrous and complete over the surface of the endobronchial portion, but showed evidence of the bronchoscopic treatments. There are no metastases in the mediastinal lymph nodes. The cut surface of the tumor had a granular appearance and sharp small bony spicules were felt as one ran his finger over it.

The histology of the tumor showed bone formation in several areas (Fig. 14) which accounts for the sharp spicules. Otherwise the picture was that of very vascular adenoma (Fig. 15).

I append a letter from Dr. Sophie Loven, of Bakersfield, a specialist in diseases of the chest, who referred this case to us. We quote this letter because it gives such a vivid demonstration of how these cases are handled—how they masquerade under various diagnoses.

"I would like to refer Mrs G D to the Thoracic Surgical Clinic for study. She is in need of a bronchoscopy. I think she has tracheobronchial tuberculosis involving the left lower lobe bronchus, which is gradually getting worse.

"Her history of tuberculosis dates back to 1929, and in 1931 she was under the care of Dr Robert Peers at his tuberculosis sanatorium for a year and a half. She has never had a positive sputum, and her general condition has been very good with very little weight change. For the last two years she has had repeated hemoptyses, and continues to run a low grade fever to 99.6°.

"On examining her on March 20, she weighed 147 lbs and looked well. This was two days after a hemorrhage. The left chest showed diminished expansion at the base, with absent vocal fremitus and dull percussion note over the lower lobe. The breath sounds were absent. There were no rales. The right lung was clear.

"On March 29, Mrs D said she had noticed wheezing, and both lungs were full of wheezes and groans. Sputum examination was negative for tubercle bacilli on March 21. She has never had any severe pleurisy."

The ease of a mis-diagnosis is readily seen by this letter. Other patients in our series have also masqueraded as tuberculous individuals.

Of particular interest is the fact that this patient, in contrast to Case 1, had very few if any episodes of fever, and the x-ray examination showed what appeared to be a minimal amount of atelectasis. The actual size of this tumor, which was found on lobectomy, was surprising. Had tomography been used, the extent of the tumor might have been evaluated earlier, and bronchoscopic removal would not have been attempted. No doubt her future would have been compromised by increasing growth and extension of the endobronchial portion of the tumor until it obstructed the left upper lobe, which would then have been liable to infection.

This is another case in our series which exemplifies the impossibility of bronchoscopic removal. Furthermore, we feel, as does Churchill (10), that lobectomy is quite sufficient in most of these cases, and pneumonectomy is not usually indicated as it would be for cancer.

CASE 3. A. B., white female, aged 31. First admitted to the University of California Thoracic Surgical Clinic on March 13, 1939.

The time of the onset of symptoms in this patient is difficult to determine. She was a delicate child,



Fig 2 H. G. No 10, Table IV. Lipiodol instillation filling dilated bronchus around adenoma in the right stem bronchus which simulates the filling of abscess.

weighing but 4 pounds at birth, and only 40 pounds at the age of 11. At the age of 4 she was severely ill from whooping cough. At the ages of 10, 12, 15, 17, and 19, she had severe "pneumonias" associated with marked dyspnea, requiring bed rest for several weeks at a time. In 1929 at the age of 22, following another pulmonary infection, the first hemoptysis appeared. The hemorrhages were small in amount and continuous throughout most of that year. During 1931, several "bad colds" occurred and wheezing was marked. Hemoptysis increased in amount to 2-3 tablespoons of bright blood. In 1932 an x-ray film of the lung was reported negative. However, lateral views were not taken, and the mediastinum was displaced to the left. This suggests that there was an atelectasis at the left base. During the next 3 years frequent "bad colds" with fever, and hemoptysis continued, but her general condition remained good enough for her to work as telephone operator.

In 1935 an x-ray film of the chest was diagnosed pleurisy with effusion, and she was sent to a tuberculosis sanatorium for 6 months. The sputum was negative for tubercle bacilli, and no pleural effusion was found. A review of these x-ray films shows further displacement of the mediastinum with a dense shadow at the left base, suggesting an increased amount of atelectasis over that found in 1932. Because of the diagnosis of pulmonary tuberculosis, she was allowed to work at intervals only. During the next 4 years, hemorrhages continued, but none was severe. The pulmonary infections required hospitalization on two occasions during this period.



Fig. 3.

Fig. 3. Case J. B. February 8, 1935. Postero-anterior view showing triangular area of atelectasis in the base of the right upper lobe.



Fig. 4.

Fig. 4. Case J. B. April 9, 1935. Postero-anterior view. Clearing of the atelectatic area after bronchoscopic removal of the adenoma.



Fig. 5.

Fig. 5. Case 1. February 5, 1940. Postero-anterior view with an overexposed film, showing the right lung. Trachea and heart displaced to the right. Numerous bones resembling cystic right lung are depicted. No definite tumor is visible.



Fig. 6, left. Case 1. February 4, 1940. Tomogram, postero-anterior view 8 centimeters from the back, showing the outline of the displaced trachea, the carina, and the right stem bronchus. The endobronchial tumor filling the right stem bronchus with larger extrabronchial lobular extensions is distinctly seen.

Fig. 7. Case 1. February 4, 1940. Tomogram, right lateral view 8 centimeters from the right side. The dilated right stem bronchus containing a rounded tumor is again seen (tip of arrow). The extrabronchial extensions at this level are not distinct.

Bronchoscopy was performed March 10, 1939. A lobulated, pink, vascular polypoid tumor completely obstructing the left stem bronchus was seen. Approximately one half the tumor was removed through the bronchoscope at this time, and the remainder of the endobronchial portion was removed 2 weeks later.

The histological diagnosis was bronchial adenoma. Some peripheral sections were composed chiefly of vascular spaces suggesting angioma, but the deeper sections showed the typical patterns of adenoma.

Bronchography after bronchoscopic removal disclosed cystic bronchiectasis in the left lung (Figs 16 and 17) and no gross bronchial obstruction.

Since the bronchoscopic removal of the adenoma, the patient has carried on her job without losing time because of respiratory illness, in spite of destruction of the total left lung by bronchiectasis. The sputum (1 or 2 ounces daily) continues, but bronchoscopic and postural drainage have prevented any exacerbation of the pulmonary infection. Bronchoscopic examinations, performed in the past year at approximately 3-month intervals, have disclosed the presence of residual intramural tumor on the posterior wall at the bifurcation of the left stem bronchus.

This is another case masquerading as tuberculosis. Slowly, almost complete bronchiectasis of the upper and lower lobes has occurred, with a minimum of symptoms. The maintenance of an air-way through the bronchus has relieved her considerably. The question of operative removal of the entire lung has been discussed with the patient but not urged, because of her present good condition—although we feel that ultimately pneumonectomy will be necessary.

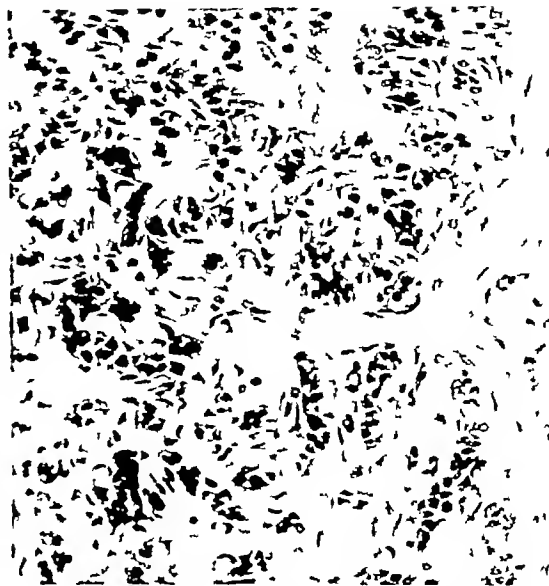


Fig 8 Case 1 March 8, 1928. Bronchoscopic biopsy showing epithelial cells arranged in cylindromatous pattern, no mitoses, uniform small pyknotic cells. First called carcinoma, changed in 1938 to adenoma.  $\times 135$ .

This patient also presents the paradox of a maximum of destroyed lung with bronchiectasis and a minimum of disability. Although we know that intramural residual tumor is present, we cannot be sure of the existence and extent of extrabronchial tumor. Tomographic studies have been requested.

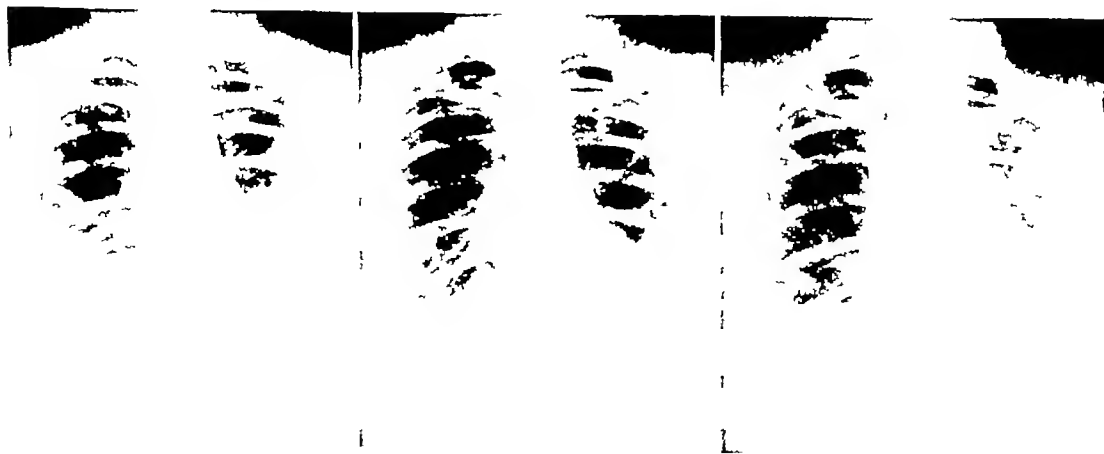


Fig 9 June 16, 1933

Fig 10 November 18, 1936

Fig 11 April 18, 1939





Fig. 3. April 8, 1939. Case 2. G. D. X-ray film showing some degree of displacement of the mediastinum and heart to the left. There is no change over the 6 year period. E. v. in the lateral view, no definite neoplasm is outlined.

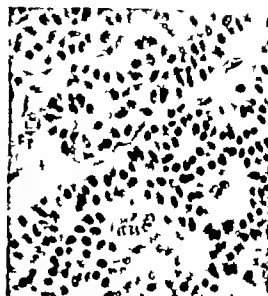


Fig. 3. Case. Bronchoscopic biopsy showing typical alveolar and cylindromatous patterns. X5.

Onset was 2 1/4 months before entry with cold and cough. Difficulty in swallowing was an early usual symptom. Hemoptyses occurred 2 days before entry. Two days later fluoroscopic examination showed no evidence of tumor or consolidation. Fifteen days before entry severe dyspnea and pain in the right chest occurred. After entry he had attacks of severe postural dyspnea, cough, cyanosis, and polydipsia which were not relieved by bron-



Fig. 4. Case. Histological section from the lobectomy specimen showing bone formation within the tumor.



Fig. 5. Case. Lobectomy specimen left lower lobe, with the adenoma cut open. Note how well encapsulated the tumor is.

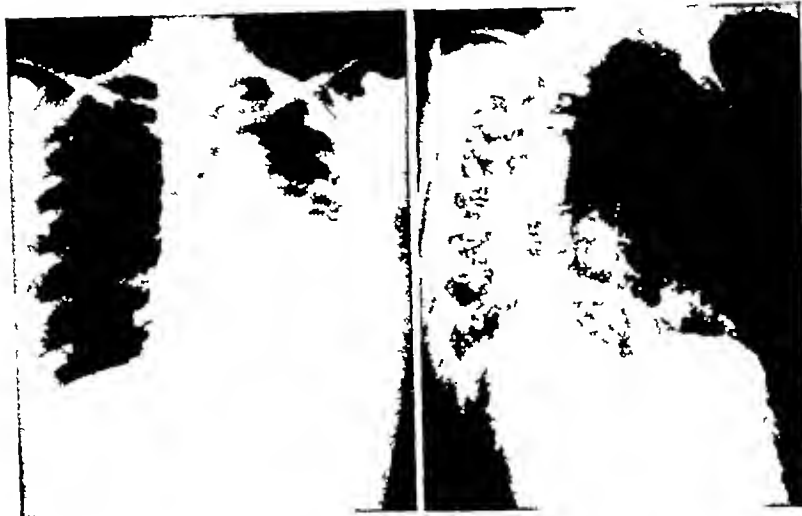


Fig 16, left Case 3 A B May 10, 1939—postero anterior

Fig 17 May 10, 1939—left oblique Case 3 Taken after the bronchoscopic removal of the endobronchial tumor Lipiodol instillation The left lung has been reduced to a system of bronchiectatic cavities The mediastinum is markedly displaced to the left, and the hypertrophied right lung has entered the left side of the thorax

choscopy, and which were made worse by lying upon the left (the apparently uninvolved) side The postural dyspnea was the most striking clinical feature exhibited by the patient It was imperative that he lie on his right side because changing onto his left side produced deep cyanosis and gasping respirations X-ray film (Fig 18) then showed opaque shadows at the left base, probably atelectasis, tension emphysema of the right lung, and deformity of the esophagus in the hilar region He died of asphyxia 6 days after entry, only  $2\frac{1}{2}$  months after the onset of symptoms

Postmortem examination showed two polypoid masses (Fig 19) The largest mass was fixed and sessile, 3.5 centimeters long by 1 centimeter thick It obstructed the left stem bronchus, produced atelectasis of the left lung, and infiltrated through the posterior wall into the esophagus The smaller one lay loosely in the right upper lobe opening, obstructed this lobe and the right stem bronchus incompletely, and produced tension emphysema of the right lung (Fig 19, A) It had a small pedicle and apparently arose from an implantation originating from the larger polypoid tumor Histological diagnosis was undifferentiated carcinoma (Fig 20)

This case illustrates carcinomatous polypoid bronchial tumors which, because of their location, produced a very short course Implantation or submucosal metastases accounted for the right-sided polyp In spite of the bronchial obstruction, x-ray films at first were without gross atelectasis Histologically, the

tumor appeared to be very rapidly growing Clinically, symptoms of obstruction to aeration (asphyxia), which were postural, were most striking

CASE 5 S W, a white male aged 19, was first admitted to the University of California Hospital on December 23, 1936

The onset was in December, 1936 with cold, cough, anorexia, malaise and weakness, followed by left pleuritic pain and blood tinged sputum, and dyspnea X-ray films showed a dense mass at the left hilum

Bronchoscopic examinations on December 24 and January 8 showed a polypoid mass obstructing the left upper lobe orifice Biopsies showed degenerated tissue and chronic inflammation

Deep x ray high-voltage (1,000,000) therapy was given with some regression of the mass which, in spite of the bronchoscopic biopsy reports, was considered to be probably carcinoma, and possibly adenoma Bronchoscopy after therapy in March, 1937, showed partial obstruction of the left upper lobe with pus coming from it

He re entered the hospital on July 6, 1937, with suppurating left lung, and fever for the past month Bronchoscopies were performed on July 2, 10, 20, and 26 A granular mass obstructing the left upper lobe and partially occluding the left lower lobe was seen Biopsies were reported to show chronic inflammation with endothelial cell proliferation

X-ray films on July 22, 1937, showed diminution of the atelectasis and no evidence of drowned lung He was discharged on July 27



Fig. 3 Case 4. H. V. June 4, 1935. Barium in esophagus. A defect in the mid portion of the esophagus, obstructive emphysema of the right and telescoping of the left lung are shown.



Fig. 20 Case 4. Section through sessile malignant bronchial polypoid tumor showing large irregular cells without forming definite palisade infiltration, and necrosis in the subbronchial elastic tissue membrane necrotic debris above on the surface of the tumor. X5.



Fig. 9 Case 4. Postmortem specimen showing sessile cylindrical polypoid carcinomas, B, obstructing the left stem bronchus, and another pedunculated polypoid tumor A obstructing the right upper lobe and right stem bronchus.

Bronchoscopies are performed on August 9, September 8 and September 20, with relief of symptoms and clearing of the opacity in the left lower lobe. The appearance of the tumor, as that of a red granular mulberry mass. Biopsies were reported to show proliferating typical cells, possibly malignant, but more inflammatory reaction, not finally carcinoma. But in spite of bronchoscopic removal of the endobronchial obstruction, rapid



Fig. 5 Case 5. S. W. December 7, 1935. One year after left total pneumonectomy showing metastases of lymphangio-endothelioma in the right lung.

recurrence was noted. This led us to believe that the tumor was rapidly growing and probably malignant.

In November, a large cyst appeared in the left lung from which bloody fluid was aspirated.

Left pneumonectomy was performed on December 7, 1937, by Dr. Stephens. Recovery was complicated by an empyema, which required drainage.

Examination of the pneumonectomy specimen showed both an intrabronchial and extrabronchial tumor, as well as a large cyst containing 500 cubic centimeters of blood. There were no metastases in mediastinal lymph nodes removed. Histological diagnosis: lymphangioendothelioma. Mediastinal lymph nodes removed contained no metastases.

For the next 10 months his condition was good but on October 2, 1938, metastatic lesions appeared in the right lung (Fig. 21). He expired on March 3, 1939, with signs of metastases to the central nervous system, liver, spleen, and right lung. No postmortem examination was made.

Because of his youth, and the failure to obtain characteristic patterns in the bronchoscopic biopsies, for nearly 2 years the diagnosis of a malignant tumor was not definitely made. The presence of an obstructing polypoid tumor led us to be conservative and



Fig. 23. Case 6. Postmortem specimen showing endobronchial pedunculated liomyosarcoma. The large distal infiltrating main portion of the tumor occupied most of the left lower lobe, not shown in this photograph.

treat the tumor as if it were an adenoma—that is, by local removal and x-ray therapy to establish bronchial drainage. When rapid recurrence after endobronchial removal oc-

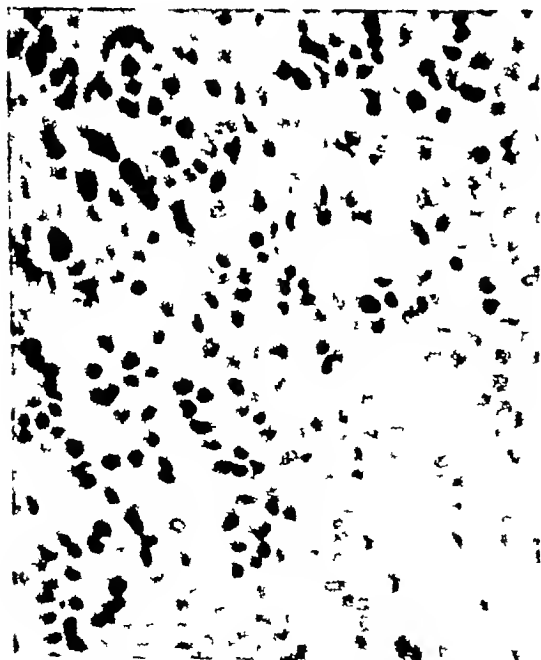


Fig. 25. Case 6. Section from the pneumonectomy specimen showing small cell which simulates the cell found in adenoma. This cell, however, shows more irregularities. Diagnosis: lymphangioendothelioma.



Fig. 24. Case 6. Photomicrograph of a section through the large extrabronchial tumor mass, demonstrating the presence of large multinucleated embryonal muscle cells.



Fig. 5. Case 7. S. J. December 28, 1935. Postero-lateral view showing large, round, discrete mass in the right upper lobe with telescading above.

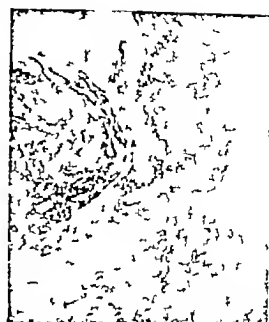


Fig. 6. Case 7. Bronchoscopic biopsy showing failure to obtain characteristic pattern. This probably comes from an amorphous covering which has so far prevented the biopsy forceps from reaching the characteristic tumor.  $\times 90$ .

curred we knew that the tumor was rapidly growing. Although patterns were obtained in the biopsy material which were definitely neoplastic, an accurate histological diagnosis was not made until the entire tumor was examined. The cell type (Fig. 22) of this tumor seen in the histological section was small and our pathologist, Dr. Connor, had great difficulty differentiating this tumor histologically from adenoma. The growth potential of this angiosarcoma was greater than that exhibited by the myosarcoma (Case 6) but less than that exhibited by carcinoma.

CASE 6. C. E., white male aged 55 admitted to the University of California Hospital on December 20, 1935.

Onset of symptoms was in 1928 with productive cough. During the years between 1928 and 1935 the patient remained in fairly good health except for occasional blood-tinged sputum and a gradual increase in the amount of bloody purulent odorless sputum, and discomfort in his left lower chest. Repeated examinations of the sputum for tubercle bacilli are negative.

On entry he was well nourished and did not appear ill. His fingers were clubbed. There were signs of consolidation over the left lower chest posteriorly.

X-ray films in November, 1935 revealed an irregular solid density in the left lower chest partially hidden by the heart, with slight shift of the mediastinal structures to the left. A definite diagnosis of a mass was not made because this shadow was interpreted as atelectasis. Bronchography was not performed.

Bronchoscopic examination by Dr. Stephen on December 30, 1935 showed triangular polypoid tumor protruding through the left lower lobe opening into the left stem bronchus (Fig. 3). It was smooth gray hard, and bled very little when the biopsy was taken.

The following is a quotation from the biopsy report: hyperplasia and degeneration of mucous glands.

On January 4, 1936, left diagnostic pneumothorax was instituted. X-ray films following the pneumothorax failed to bring out any more detail than was previously seen in the plain films which were made of the chest.

A second bronchoscopy was done on January 5, 1936. The findings are the same as those of the first bronchoscopy and the biopsy was inconclusive. The patient was advised to have lobectomy of his left lower lobe, but he refused operation. His condition remained stationary for the next 5 months.

He continued to cough up bloody sputum and in June, 1936, for the first time had an acute infection in the obstructed lobe. Bloody pleural fluid developed which showed tumor cells. He died in August, 1936.

Postmortem examination by Dr Mason<sup>1</sup> showed an elongated polypoid tumor mass which measured 4 by 1 by 1 centimeter obstructing the left stem bronchus (Fig 23), and was attached by a small, thin, mucosal pedicle to the bronchial wall at its distal portion. The surface was covered by a layer of organized inflammatory material. Distal and separate from this was a large, white and yellow, infiltrating tumor which occupied all of the left lower lobe. There were distant metastatic pleural plaques 1 to 2 inches in diameter, but no mediastinal or other metastases.

Histological examination showed some differences in the two tumor masses, and the diagnosis by Dr Rusk was leiomyosarcoma (Fig 24). There was nothing found to indicate that the large, extrabronchial mass arose as a result of malignant degeneration of the separated polypoid bronchial tumor. On the other hand, the small pedicle of the intrabronchial tumor would indicate that its origin was from direct implantation upon bronchial mucosa or submucosal lymphatic metastasis.

The large extrabronchial tumor was probably slowly growing and resectable when first observed. Early exploratory thoracotomy would have prevented unnecessary delay.

Because of the long history and sudden terminal course, this case brings up the possibility of the development of a carcinoma from a benign polypoid bronchial tumor. But the postmortem examination showed that the intrabronchial polypoid tumor was completely separated from the large extrabronchial mass. He lived only 10 months after the exacerbation of his symptoms. In spite of two bronchoscopies and the accessibility of the tumor, characteristic patterns were never obtained because the biopsy material was too superficial. The growth potential exhibited by this tumor was low. It seemed greater than adenoma, but less than the lymphangio-endotheliosarcoma.

CASE 7 S J, white male, aged 50. The onset of symptoms began in August, 1938, with non-productive cough and later wheezing. An x-ray film of the chest was diagnosed tuberculous infiltration of the right upper lobe (Fig 25). The sputum was negative for tubercle bacilli. The patient was worried that he might have a cancer of the lung because his mother, one brother, and a sister had all died of cancer. Hemoptysis was not present. Bronchoscopy was first performed on November 23, 1938, by Dr S Shipman. The right stem bronchus was found to be almost completely stenosed by

a large, pale mass of tissue apparently arising from the right upper lobe opening and growing out onto the main bronchus. There was slight bleeding when biopsies were taken from the obstructing mass. Microscopic examination of the biopsy pattern as (Fig 26) revealed an indefinite papillary pattern although originally there might have been fibrous connective tissue cores lined by degenerated epithelium. X-ray examination (Fig 25) of the chest on December 28, 1938, showed the density in the right upper lobe, with some shift of the mediastinum to the right. It was impossible to be certain of the outline of the tumor in this film.

Deep x-ray therapy was administered to the right upper lobe from November 30, 1938, to January 19, 1939. A total dosage of 10,200 r was given over the right upper chest.

X-ray films on January 11, 1939, revealed an increase in the shadow in the right upper lobe. Bronchoscopy was repeated on March 15, 1939, and May 5, 1939, with no significant change in the appearance of the mass in the right main bronchus. The biopsy material from these examinations is very similar in appearance to the original material removed, and shows no characteristic patterns.

At the present time the patient is working regularly as a salesman, and is free of symptoms, 20 months after the onset, but the x-ray films of his chest are unchanged.

Exploratory thoracotomy has been advised in this case, but the patient has refused. Again the tough overlying amorphous coating of the endobronchial portion of this tumor has prevented the biopsy forceps from removing characteristic sections of the tumor (Fig 26).

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<sup>1</sup>We wish to thank Dr Eleoesser and Dr Mason for permission to use this case.

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# FACTORS IN RECURRENCE OF VARICOSITIES FOLLOWING TREATMENT

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NO wholly satisfactory treatment for varicose veins of the extremities has been devised. This is undoubtedly due to the fact that various factors concerning the anatomy, physiology, and pathology of the underlying condition are not yet thoroughly understood. With all types of treatment there have been a large percentage of recurrences in spite of the fact that the immediate results have been encouraging. No type of therapy for the relief of varicose veins of the lower extremities is new. All have been tried, have been discarded, and have reappeared at one time or another.

The period of radical surgical procedures, which included excision and stripping, was followed by an era of nonoperative or simple treatment by injection. Careful studies, however, soon demonstrated an enormous percentage of recurrences after simple injections. There was also a certain group of cases in which complete eradication of the varicosities could not be obtained by this method. This was particularly true in those cases in which incompetency of the great saphenous system was present. Normally, numerous competent valves break the pressure of the column of blood in the great saphenous vein. The most important valve is at the saphenofemoral junction and, when incompetency occurs, any increase in intra-abdominal pressure, such as that produced by coughing and straining, thrusts the force of the blood column in the iliac and inferior vena cava on the great saphenous vein. This condition alone was sufficient in many cases to prevent complete sclerosis of the incompetent system by simple injection. When complete thrombosis did occur, the pressure of the column of blood caused rapid canalization of the thrombus and reappearance of the varicosities.

More than 50 per cent of the patients treated at the Mayo Clinic for varicosities of the lower extremities have had associated incompetent great saphenous veins. The incidence of recurrences reported by others has been observed by us in this group when simple injection treatment was carried out. This factor of downward pressure, together with other reasons for recurrences, has been eliminated in the past few years by performing a combination of division and ligation of the great saphenous vein together with injection of a sclerosing solution into the portion of vein distal to the site of ligation at the saphenofemoral junction, together with separate division and ligation of its uppermost tributaries (1, 3). We believe that this procedure is an essential part of treatment for varicosities in which incompetency of the main saphenous trunk can be demonstrated. It is today the most satisfactory method of treatment for this group of varicosities. Even following this treatment, a high incidence of recurrence of the varicosities has been reported by some workers. In our experience with more than 700 cases the incidence of recurrence in this group has been exceedingly small. For the most part, recurrences in this group can be prevented if the many variations in the anatomy of the great saphenous vein and its tributaries at the fossa ovalis are recognized and adequately treated at the time of operation. It has been our impression, after careful examination both clinically and at the time of a second operation, that the recurrences which we have seen, both in our own cases and in those in which the original treatment was performed elsewhere, have been due to technical mismanagement of the primary operation.

Unfortunately, no matter what method of therapy is used for varicose veins, one cannot expect to eliminate entirely the tendency





Fig. 1. Normal anatomical relationships of the great saphenous vein and its tributaries at the fossa ovalis.

toward the development of varicosities. Thus, varicosities occasionally develop in these patients in previously uninvolved veins but, of course these cannot in the true sense of the term be called recurrences. The new varicosities if the original treatment has been adequate are for the most part of minor consequence and respond readily to treatment by local injection.

#### ANATOMICAL CONSIDERATIONS

Unless the variations in the anatomical relationships of the great saphenous vein its tributaries and the surrounding structures in the region of the fossa ovalis are recognized, one is likely to overlook some condition which may result either in a complete or a partial failure of the operation with resulting persistence or recurrence of an incompetent great saphenous system. We have previously described a technique which has made it possible for us adequately to expose the incompetent great saphenous vein and its various tributaries.

**Normal anatomical relationships** The great saphenous vein ends in the femoral vein at the fossa ovalis. Just distal to its junction with the femoral vein there are three comparatively constant tributaries, the superficial circumflex iliac, the superficial epigastric, and the superficial external pudendal veins (Fig. 1). The superficial circumflex iliac vein receives blood from the lower and lateral part of the abdominal wall and the proximal and lateral parts of the thigh. The superficial epigastric vein drains the lower and medial part of the abdominal wall, and the superficial external pudendal vein receives blood from the dorsum of the penis and the scrotum in the male and from the labium majus in the female.

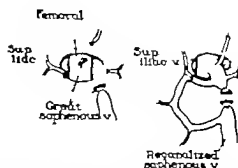


Fig. 2. At left, proper method of ligation of the great saphenous vein. At right, recurrence of varicosities by shunting of blood through patent tributaries that were not ligated.

It is important to recognize and separately divide and ligate these tributaries together with division of the great saphenous vein at the saphenofemoral junction otherwise there will be a shunting of the blood through the various tributaries until finally there is canalization of the portion of the divided great saphenous vein that lies distal to the site of the ligation as is shown in Figure 2.

In some instances, when these tributaries are not divided and ligated separately varices form over the lower part of the abdomen, and over the scrotum, labia, and other regions that are dependent on the distribution of the vein. Frequently recurrence of varicosities and canalization of the great saphenous vein can be predicted at operation if large patent tributaries are found and are not ligated. The uppermost tributaries enter the anterior and lateral wall of the saphenous vein in the great majority of instances. They can always be exposed by retracting the surrounding tissues upward and by simultaneously making traction downward on the proximal stump of the divided saphenous vein (3). Exposure can be facilitated by stripping away the loose areolar tissue on the posterior aspect of vein back to the femoral vein. Inasmuch as no tributaries are found on the posterior aspect of the vein this can be safely and easily done with the index finger.

**Superficial femoral veins** Slightly more distally two tributaries, the lateral and medial superficial veins, may be found (Fig. 3). Many authors describe these as compara-

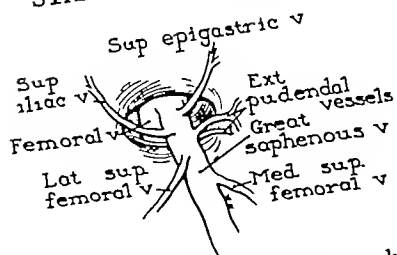


Fig 3. Great saphenous vein at fossa ovalis showing lateral and medial superficial femoral veins.

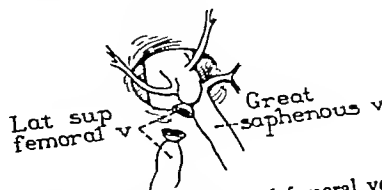


Fig 4. Dilated lateral superficial femoral vein ligated and incompetent great saphenous vein overlooked.

tively constant findings in the surgical approach to saphenofemoral junction, but in our experience this has not been confirmed. In approximately 10 per cent of our cases, one or the other or both of these superficial femoral veins has been visualized. The lateral vein is seen more frequently than the medial, and both are seen more frequently than the medial alone. If either of these tributaries enters the great saphenous vein at a sufficiently proximal level to be visualized in the surgical field described, they frequently are incompetent. They may become dilated to such a size that the surgeon might easily mistake this dilated vein for the great saphenous vein itself and unless adequate dissection is carried out this vein might be left unligated (Fig 4). We have performed many secondary operations on patients for persistence of incompetency of the great saphenous vein following its supposed ligation. Invariably an incompetent superficial femoral vein has been found to have been ligated at the primary operation and the saphenous vein completely overlooked.

The lateral vein ascends from the lateral side of the knee and courses medially and anteriorly over the thigh to enter the great saphenous vein as described. The medial vein ascends from the posterior aspect of the thigh, along its medial side and terminates near the fossa ovalis. When these veins are incompetent, their presence can usually be determined by careful examination of the patient's thigh. Varicosities will be seen following the course of either the lateral vein, the medial vein, or both of them, and in addition an incompetent saphenous vein can frequently be demonstrated.

At operation, the lateral and medial superficial femoral tributaries can be distinguished from the great saphenous vein if adequate exposure of the saphenofemoral junction is obtained. The saphenous vein lies slightly deeper than the superficial veins. It promptly curves medially from the femoral vein at an angle of approximately 35 to 45 degrees and may lie directly on the deep fascia. The lateral superficial vein courses anteriorly down the middle aspect of the upper part of the thigh running almost parallel to the femoral vein for a short distance and then it curves laterally. It also runs into the subcutaneous fat and is definitely more superficial than the saphenous vein. As the superficial femoral veins are exposed upward, the absence of tributaries and the absence of the deep pudendal artery should serve to distinguish it from the saphenous vein. In some cases, these superficial veins are present without incompetency but if they are not divided and ligated separately, incompetency soon develops. We have seen a few instances in which there was marked demonstrable incompetency of the superficial femoral veins with but little incompetency of the saphenous vein. In any event when a superficial femoral vein is found it should be separately divided and ligated and if it is dilated a small amount of sclerosing solution should be injected. We, in our earlier writings, and some other authors have called these superficial veins, accessory veins. It should be pointed out that they are normal tributaries of the great saphenous vein, but usually are not encountered at a sufficiently high level often enough to be consistently visualized in the surgical approach to the saphenofemoral junction.

Other recurrences have been demonstrated as a result of division and ligation of the great saphenous vein at too low a level with per-



Fig. 5. Improper ligation of great saphenous vein with persistence of incompetent lateral superficial femoral vein.

sistence of an incompetent lateral superficial vein (Fig. 5). When this situation is present rapid canalization of the saphenous system and recurrence of the varicosities occur.

In a few cases, the medial superficial femoral vein has been left patent. Inasmuch as this vein frequently joins the small saphenous vein, recurrence of the varicosities is usually rapid.

**Variations in tributaries.** Although the courses of the three most proximal tributaries are comparatively constant a few variations which have proved confusing have been encountered. Uncommonly these uppermost tributaries of the great saphenous vein empty directly into the lateral superficial femoral vein (Fig. 6). In other instances, only one or two of these tributaries enter the superficial femoral vein whereas the remaining tributaries enter the saphenous vein.

A very uncommon situation is for the tributaries to enter the femoral vein directly (Fig. 7). When this occurs they either enter the femoral vein through the fossa ovalis as shown or first they pierce the deep fascia at a distance from the fossa ovalis. In the former situation the vessels can be ligated without more difficulty than usual but in the latter group ligation is usually very difficult.

**External pudendal artery.** Occasionally certain variations in the situation of the pudendal arteries make high ligation of the saphenous vein more complicated than usual and for this reason have proved in a few cases, to be secondary factors in recurrence. The deep external pudendal artery crosses from the femoral artery in 90 per cent of cases, across the lower border of the fossa ovalis (Fig. 1). When present in this situation it is easily recognized and acts as an accurate landmark of the saphenofemoral junction. As a rule

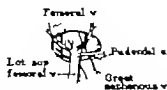


Fig. 6. Uppermost tributaries of great saphenous vein emptying into lateral superficial femoral vein.

this deep artery is seen posterior to the saphenous vein, but in 10 per cent of cases it crosses anterior to the saphenous vein. When this latter relationship exists the artery is usually found a short distance below the various tributaries and it may hold down the saphenous vein so that the saphenofemoral junction cannot be exposed without first dividing the artery. Occasionally the deep pudendal artery passes beneath the lateral superficial vein and anterior to the great saphenous vein as shown in Figure 6. As a rule the superficial pudendal artery is not visualized, but it may be seen when the superficial epigastric vein is exposed. Care must be taken to prevent unrecognized injury to either of these vessels at operation because annoying hemorrhage may result. When the deep pudendal artery is in its usual position it may prove to be a useful adjunct in confirming the upper limits of the saphenous vein, but its variations from the normal must be recognized or one will be more likely to overlook proper ligation, and in some cases, entire ligation of the great saphenous vein.

**Failure to excise segment of vein.** It has been our observation that following simple ligation of the saphenous vein with subsequent infection recurrence of the varicosities subsequently develops. In some cases we have found the saphenous vein ligated but without a segment excised. In these instances, recanalization of the great saphenous vein has taken place rapidly. At operation, this was found to be due to re-establishment of a channel directly through the ligated portion of the vein. As has been pointed out, when approximately 2 inches (5 cm.) of vein have been excised, but with the tributaries left intact the recurrenser has been due to shunting of the blood through the various tributaries.

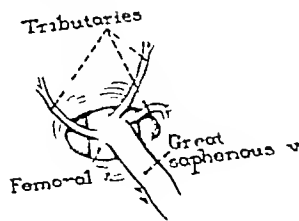


Fig 7 Uppermost tributaries of great saphenous vein emptying directly into femoral vein

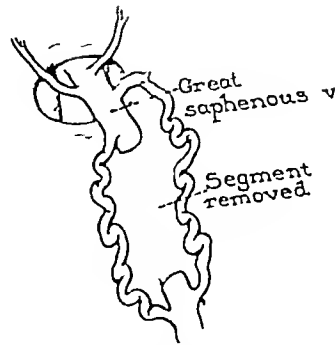


Fig 8 Method of recurrence of collateral venous circulation following stripping and excision of segment of great saphenous vein

*Recurrence following stripping and excision*  
What has been said herein about recurrences following combined division and ligation of the great saphenous vein, can be said to a greater degree about the procedure of stripping and segmental excision. This procedure frequently brought about encouraging early results but was invariably followed by recurrences. These were largely due to a shunting of the blood from the various tributaries (Fig 8). If the stripping had begun at the saphenofemoral junction and if attention had been paid to the various tributaries of the saphenous vein, the permanency of the results would undoubtedly have been much greater. We have operated on several patients who previously had had the stripping operation performed and who come to us because of a recurrence of their varicosities. In all of these cases it has been possible to demonstrate the presence of large incompetent great saphenous stumps with communication between a long proximal stump and the lower segment by means of new channels formed from the various tributaries.

As a result of re-examination of, and operation on, a group of patients who had a recurrence of varicosities following operative treatment of the great saphenous vein, both by us and by others, we feel that the vast majority of recurrences in this group has been due either directly or indirectly to some technical difficulty encountered at the initial operation. We have pointed out some of the more common variations in the anatomical relationships of the great saphenous vein at the fossa ovalis which in our experience have proved confusing and in some instances have served as a cause of recurrences. The majority of recurrences has been due to the failure to ligate the

saphenous vein at the saphenofemoral junction and to divide and to ligate the various tributaries separately. Frequently, persistence of an incompetent saphenous vein has been demonstrated when the lateral superficial femoral vein has unwittingly been ligated for the saphenous vein. In other instances, failure to divide and to ligate the superficial femoral veins or to excise a segment of the saphenous vein have been factors in recurrences. Inasmuch as one dislikes to dismiss a patient as cured when a recurrence is inevitable, careful examination should be made before dismissal.

In many cases if a basic understanding of these variations in anatomical relationships already considered is recognized, a recurrence of the varicosities can be prevented or predicted. For this reason a reiteration and consideration of some of the methods employed in predicting recurrences and of the treatment which is employed in these cases seem apropos.

#### METHOD OF PREDICTING AND TREATMENT OF RECURRENCE

The presentations in this paper again emphasize the importance of a carefully detailed examination. This is true in all phases of medicine, varicose veins being no exception. The presence of an incompetent great saphenous system cannot be determined satisfactorily in any case unless the first three cardinal principles of a physical examination are employed, namely, inspection, palpation,

and percussion (2) The great saphenous vein is only one portion of the great saphenous system; thus, the examination for varicosities is not complete without a thorough investigation of its tributaries particularly those that arise in the region of the fossa ovalis. If varicos appear on the thigh other than along the usual course of the great saphenous vein we immediately suspect that one or more of the tributaries entering the great saphenous vein is also incompetent. If they are situated on the anterior lateral aspect of the thigh, an incompetent lateral superficial femoral vein has probably broken down. If on the medial or posterior aspect of the thigh, the medial superficial femoral vein has probably been affected. By determining before operation whether or not one or both of these two rather commonly involved tributaries are incompetent one can predict with sufficient accuracy what anatomical relationship exists between the great saphenous vein and its tributaries frequently this materially simplifies the dissection at time of operation, if a difficult dissection should be encountered.

The affected extremity is examined in its entirety daily following the ligation and division of the great saphenous vein and the injection of a sclerosing agent into the great saphenous vein and its tributaries. We note the veins involved and the extent of the reaction produced by the sclerosing fluid introduced. The extent of the thrombosis that has occurred is proportional to the pinkish-red region of perivenitis. When palpated this region is tender and if thrombosis has occurred a definite cord like structure can be felt. If this reaction does not extend throughout the entire incompetent system, as it infrequently does, further injections of sclerosing solution must be administered to complete the thrombosis of the remaining patent varicosities. Those patent varicosities that remain following the initial surgical procedure are less tense on palpation and are easily obliterated by small amounts of sclerosing solution. If suprapubic or labial veins were distended prior to their interruption at operation it will be observed frequently that they decrease materially in size and often become thrombosed even without the introduction of

a sclerosing solution. Most dramatically portraying the elimination of venous stasis, however are those patients who have such complications of stasis as dermatitis or ulcer. Most patients who have complications of stasis have associated incompetent great saphenous systems. At the Mayo Clinic marked improvement of these lesions has immediately followed adequate treatment of the offending veins as described.

On the other hand if little or no perivenitis is visible along the course of the supposedly treated varicosities or if the vein has a tense doughy consistency on palpation and complications of stasis do not heal as rapidly as expected the possibility that the surgical procedure instituted may not have been adequate must be considered. This early information will no doubt be substantiated by the difficulty in obliteration of other patent varicosities and the large amounts of solution necessary to produce a firm thrombus in the main channels of the great saphenous system. Occasionally even though an adequate surgical procedure has been carried out, there is a certain small group of patients that remains resistant to obliterative therapy. These individuals ultimately should derive the desired benefits although the effort and the time necessary to accomplish a good result are definitely longer.

Two instances in which inadequate obliterative therapy may persist even though the proper surgical technique has been employed are (1) congenital arteriovenous fistula and (2) marked diffuse varicosities associated with pregnancy. In either instance an inadequate result is not immediately evident because usually a few weeks are required for the previously treated varicosities to recanalize particularly in this true in cases of congenital arteriovenous fistula. A few illustrative reports of cases are of interest.

#### REPORT OF CASES

**CASE (Simple Ligation)** Only temporary benefit was obtained from previous ligation. Varicosities reappeared within a month accompanied by complaints similar to the initial ones. At the time of the second ligation of the great saphenous vein, an anular constriction (inch (5 cm) distal to the saphenofemoral junction) was observed. This was the

# STALKER AND HEYERDALE RECURRENCE OF VARICOSITIES

only evidence to show that the great saphenous vein had been ligated. Apparently, although the vein had been ligated, it had not been divided, thus allowing rapid recanalization of the system.

CASE 2 (Tributaries providing detours) Approximately 6 months following the original ligation, varicosities reappeared throughout the lower extremity. It was not until more than a year had passed that symptoms referable to these varicosities, such as dull aching pain, tenderness, and heaviness, reappeared. On examination the great saphenous vein was found to be incompetent, and another operation was recommended. Exposure through the old incision revealed an incompetent great saphenous vein although it had been previously ligated and divided. It was found, on further dissection, that the superficial circumflex iliac and superficial epigastric veins were patent and had produced a communication between the proximal 2 inch stump of the great saphenous vein and its distal portion thus allowed complete recanalization.

CASE 3 (Complicating incompetent bilateral superficial lateral femoral veins) Eighteen months prior to registering at the clinic, this patient underwent bilateral ligation for incompetent greater saphenous veins. Following this operative procedure the bilateral ulcerations of the lower portions of the legs improved for a few weeks and then gradually became somewhat worse than formerly. This was associated with considerable pain, dull aching, heaviness and swelling of the legs. Examination at the clinic revealed what appeared to be incompetent greater saphenous systems, bilaterally. By careful dissection, at operation, we were able to demonstrate that on the left side, the lateral superficial femoral vein previously had been ligated and divided, and that apparently the incompetent saphenous vein was overlooked. On the right side the reverse was true, the incompetent superficial femoral vein had been overlooked in this instance. Following re-ligation bilaterally, the complications of stasis healed rapidly.

CASE 4 (Multiple ligations and strippings) Fourteen years previously, the patient underwent multiple ligations and strippings throughout both lower extremities with fair results for a number of years. Gradually the varicosities have returned, the patient stated that they are much worse now than prior to the operative procedure, years ago.

Examination revealed incompetent veins bilaterally which did not seem to follow the usual course of any of the tributaries of the great saphenous system, as they were diffusely scattered throughout the whole of the medial aspect of the thighs. Bilateral ligations were performed and revealed incompetent proximal saphenous stumps bilaterally, with the usual tributaries. They had apparently enlarged and extended, forming an incompetent collateral circulation with the veins distal to them, substituting for the previously excised veins on both sides. A satisfactory result was obtained following numerous local injections of a

sclerosing solution into the remaining diffusely scattered varicosities.

In such cases as the aforementioned, operation is definitely indicated. This is followed by local injections until the obliterative therapy is complete. As yet, no patient returning for observations following a second operation has had further complaints referable to varicosities. Frequently, it has been difficult in these cases to demonstrate any evidence of the previous existing varicosities.

We do not mean to imply that all individuals who present patent varicosities following previous operative procedures require further operation, even though some varices have reappeared. We have observed patients who have had a satisfactory obliteration of the great saphenous vein itself but have presented subsequent patent varicosities elsewhere on the extremity. Either by canalization or by the apparent obliteration of new channels. Generally, these varices will respond readily to local therapy. This group of patients, however, is repeatedly observed for the development of further varices.

It is important in all cases in which recurrent varicosities develop, to consider the possibility of either partial persistence or canalization of the saphenous system. If such can be demonstrated, the necessity of another operation must be considered.

## SUMMARY

A knowledge of the anatomical relationships of the venous system of the lower extremities is a prerequisite to an understanding of proper treatment for varicose veins. The continuity of the veins of the lower extremity with those of the abdomen explains canalization of a thrombosed vein or dilatation of collateral vessels that act as shunts around the site of ligation of the saphenofemoral junction. Through these shunts, hydrostatic pressure augmented by spasmodically variable intra-abdominal pressure is brought to bear on the veins distal to the site of ligation. It is, therefore, necessary to divide and to ligate, at the proper site, not only the great saphenous vein but also its tributaries, separately. However, the relationship of these tributaries to the

parent vein is not always constant. Therefore a sufficiently wide exposure of the region near the fossa ovalis is necessary for their proper identification. Even then unless care is exercised a dilated superficial femoral vein may be mistaken for the great saphenous vein. The failure to excise a segment of vein may lead to recurrence of varicosities owing to canalization. The injection of a sclerosing solution at the time of operation, into the portions of divided veins distal to the site of ligation is of definite advantage.

A carefully detailed examination including inspection, palpation and percussion, cannot be stressed too greatly as both a pre-operative and postoperative procedure. It is as important to know after operation whether or not

the veins are properly thrombosed as to know before operation the condition of the veins and the treatment indicated. If after operation certain portions of veins are found to be sufficiently affected by thrombosis, local obliterative therapy should be performed before the patient is dismissed from the physician's care.

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# STUDIES IN MALIGNANT TESTIS TUMORS

## III —Incidence and Nature of Tumors in Ectopic Testes

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THE incidence of cancer in ectopic testes has been greatly underestimated, due mainly to the lack of consideration given to many cases reported in the literature. The two most recent reviews of testicular tumors listed the occurrence of 156 and 160 cases, respectively (29, 23). The present report is based upon a survey of over 7,000 case records of testicular malignancy and is an attempt to define the relationship of ectopy to testicular cancer. The importance of such a correlation has long been recognized by general surgeons, urologists, pediatricians, and others called upon to treat cryptorchidism. The rapidity of metastasis and the admittedly fatal outcome of untreated testicular tumors attach significance to the condition and necessitate prompt and adequate treatment. Such treatment requires knowledge of the carcinogenic potentialities of the ectopic testicle. It was deemed worthwhile, therefore, to analyze the total collected cases of malignancy in ectopic testes with regard to (a) incidence, (b) description and natural history, and (c) the management of the patient with an undescended testis from the standpoint of potential carcinogenesis in the organ.<sup>1</sup>

### INCIDENCE

*Tumors of the testis* Records of various large hospitals show that tumors of the testis tabulated by these institutions constitute from 0.06 to 2 per cent of all cases of cancer in males. Probably some of these figures are somewhat high due to the concentration of such patients in specialized hospitals.

A more uniform estimation of the incidence is obtained from reports of the United States

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<sup>1</sup>A complete bibliography of studies of cancer of ectopic testes is appended in a forthcoming monograph.

Bureau of Census. Over a period of 7 years, 2,071 deaths resulting from malignancy of the testis constituted 0.3+ per 100,000 deaths and 0.64 per cent of the total number of males dying of cancer.

The figures provide only a rough index of incidence, since it is obvious that figures calculated as a percentage of the total number of deaths from cancer are liable to fluctuation with any change in the early recognition and treatment of either cancer in general, or testis tumors in particular. Perhaps a better estimation of the incidence of testis cancer than that in terms of the number of patients who die from this tumor—as compared with the number who die from all other types of cancer—is to be obtained from the fact that in the United States in 1930 there were 62,137,080 males and 270 recorded deaths from testicular tumors. If the average duration of life in the patient with a testicular tumor be assumed to be 3 years, for the purpose of providing a rough index, approximately 810 males were so affected, an incidence of 0.0013 per cent of living males.

*Cryptorchidism* The incidence of testicular ectopy in various hospitals varies from 0.3 in Buenos Aires (Arce) to 4.7 at Memorial Hospital (Coley), but hospital figures do not provide a true index of the incidence of cryptorchidism. There is a tendency toward a preponderance of certain types of patients on surgical or urological services. Inguinal hernia, for example, is commonly associated with cryptorchidism. Conversely, many cases of unilateral ectopy, especially those in which the patient is fertile, may escape attention unless accompanied by concomitants such as hernia.

Army records afford data that are numerically greater, more inclusive and representative, although even these figures are not en-



TABLE I.—COMPARISON OF TUMOR INCIDENCE AND ECTOPY

Before higher percentage of malignancy is assigned to any particular site of ectopy the tumor incidence in any ectopic area must be compared with the incidence of ectopy in that area. Viewed in this manner the larger number of inguinal than abdominal tumors is related to the greater number of inguinal ectopies.

Malignancy in ectopic testicles				Testicular ectopy				Malignancy in relation to the relative frequency of site in ectopy	
Abdomen		Inguen		Abdomen		Inguen			
Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Abdomen	Inguen
145	41.3	400	21.7	164	16.4	316	49	41.3 (58.6) 9	21.7 (49) 100

turely free from criticism. Some of the men may have had previous orchidopexy or hernia repair and so be listed at the time of recruiting as without cryptorchidism. The figures given for the men drafted in the United States Army include anorchidism, monorchidism, and cryptorchidism. It is reasonable to assume that under the term anorchidism there has been included a small number of men who never had ectopy but instead a congenital absence of a testicle, or possibly orchidectomy following surgical repair of hydrocele, hematocele, torsion of the cord, hernia, or various other conditions. Since methods were not employed to differentiate pseudocryptorchidism adequately from true cryptorchidism cases of spastic retraction of the testicle may also have been included but as pseudocryptorchidism is chiefly of prepubertal occurrence and tends to disappear after puberty the degree of confusion of spastic retraction with true retention need hardly be considered as a major source of error. By and large the percentage of 0.23 is probably essentially correct, as it is the average incidence in almost ten million adult males of service age in America, France, England, Scotland, and Austria.

*Testis tumors associated with cryptorchidism.* Of over 7,000 recorded cases with cancer of the testis, 840 were found associated with ectopy.<sup>1</sup> The incidence of ectopy in this tumor series is approximately 11 per cent. Thus more than one of every 10 men reported to have testicular cancer also had cryptorchidism—an incidence far above that of cryptorchidism in the adult male population, as is obvious from the fact that about 0.23 per cent of adult males exhibit cryptorchidism.

#### ECTOPY AND MALIGNANCY

*Definite association of malignancy with ectopy.* That 11 per cent of all testicular tumors occur in the 0.23 per cent of males who are cryptorchid proves that neoplastic growth is found far more commonly in the ectopic than in the scrotal testis, about 48 times more often than expected from chance association.

Of patients with unilateral cryptorchidism and one testis tumor 96.8 per cent had the tumor in the undescended testicle (Fig. 1). Thus in an overwhelming number of the unilaterally cryptorchid men, the tumor was in the retained testicle.

Reports of 5 patients with cancer of a supernumerary testis but not of the normally descended scrotal testes of either patient suggest again that the congenitally ectopic testis may have an associated malignant potentiality greater than the normally placed testis.

Of the 69 men with bilateral cryptorchidism and cancer of the testis, the tumors were bilateral in 24.6 per cent (Fig. 2) whereas of approximately 6,500+ cases in which tumors occurred in scrotal testes, 0.7 per cent were bilateral. Therefore in the cryptorchid patient with one testis tumor the possibility that another ectopic testis may also prove to be tumorous is great, being one chance in four whereas the likelihood of involvement of the other scrotal testis when one scrotal testis is malignant is less than one in a hundred. Thus, although no particular type of tumor seems to so predispose (Table IV) the tumor potentiality of the second ectopic testis is extremely high, about 32 times that of the second testicle of males without ectopy. But even in patients without ectopy who have one testis tumor the tumor incidence of the second scrotal testis is far above that of the general adult male

<sup>1</sup>One hundred and thirty-nine cumulative and possibly duplicating cases were not included because of lack of detailed data.

population, 10 per cent compared to 0.0013 per cent. The inference is obvious that in the management of the patient with a single testis tumor, the other testis is a matter of grave concern, pronouncedly so, if the patient has bilateral ectopy. Management of the bilaterally cryptorchid patient who has one testis tumor is somewhat parallel to the dilemma presented by unilateral ovarian and mammary cancer.

*Ectopic position not necessarily the cause of malignancy.* The high correlation between malignancy and testicular ectopy should not lead to the unproved assumption that the position of the testicle is, *ipso facto*, the factor responsible for malignancy. The potentially malignant nature of the ectopic testicle is no proof that ectopy is carcinogenic or that the cancer is the result of any ectopic residence.

Tumors in normally descended scrotal testicles have occurred in 23 men whose other testicle was undescended but did not undergo malignant change. This illustrates the caution that must be observed in drawing any conclusion that the cryptorchid site *per se* is the cause of tumor formation.

There is no evidence that any particular site of ectopy or even a condition of ectopy hastens carcinogenesis, the average age at which testicular malignancy is observed and the relative incidence at various ages (Fig. 3) are almost identical in abdominal and in in-

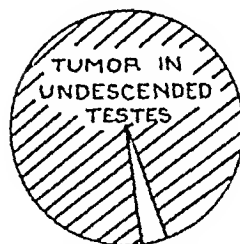


Fig. 1. Of 744 unilaterally cryptorchid patients with cancer of one testis, the tumor was in the undescended testis in 721 cases, or 96.8 per cent.

guinal ectopy. Thus there is no indication that either the abdomen or the inguen is a more favorable site for the early appearance of cancer.

It may be misleading to compare too closely the average age of the patient at which cancer was recognized in scrotal as opposed to ectopic testicles, since ready access and opportunity for continued observation of the scrotal testicles may be expected to result in somewhat earlier recognition. Yet this does not fully account for the much earlier average age at diagnosis of tumors in scrotal testes. It is hardly probable that tumors have appeared in the ectopic testicle as early as in the scrotal testicles yet exist unrecognized and not be lethal for 3 more years. Explanation of the 3 years' difference in time of diagnosis might be (a) that an ectopic position *delays* the appearance of the tumor or (b) that a particular

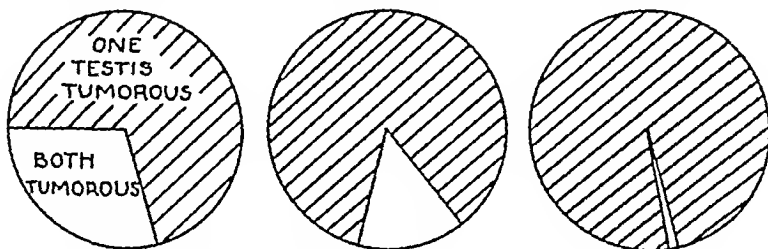


Fig. 2. In men with testicular cancer, both testes were involved (each tumor presumably primary) in 13 (30.2 per cent) of 43 men with bilateral abdominal cryptorchidism, in 4 (15.4 per cent) of 26 men with inguinal cryptorchidism. Cancer of both testes was noted in 60 (0.7 per cent) of 6,200 men who had scrotal testes and testicular cancer. Figure 2 shows that the likelihood of tumorigenesis in the second testis in the patient with testicular cancer is extremely high, especially in men with bilateral inguinal and abdominal cryptorchidism. In the man with scrotal testes the 0.7 per cent incidence of cancer in the remaining testis is some 770 times the likelihood of cancer occurring in either testis of the normal male. The potential carcinogenic tendency of the second testis in a man with cancer of one testis is probably still greater than represented in these data, for in almost all of the reported cases patients died from metastatic growths before an appreciable interval of time was allowed for cancer to appear in the second testis.



TABLE III—METASTATIC DISTRIBUTION

Determined at autopsy in patients with various types of cancer in abdominal as contrasted to inguinal testes

Type of tumor	Site* of ectopy	Num ber autops-ies	Metastases																	
			Occur-ence		To retro-perito-neum		To lungs		To liver		To other abdominal organs		To media stinum		To cord		To other organs		None	
			No	Per cent	No	Per cent	No	Per cent	No	Per cent	No	Per cent	No	Per cent	No	Per cent	No	Per cent	No	Per cent
I Unicellular	I	16	14	87.5	16	100	5	31.2	4	25	3	18	5	31.2	4	25	2	12.5	2	12.5
	A	41	33	82.4	37	90.2	10	24.4	8	19.5	7	17.1	6	14.6	0		5	12.2	8	19.5
II Teratoid	I	7	7	100	7	100	5	71.4	4	57.1	3	42.9	2	28.6	2	28.6	3	42.9	0	
	A	16	15	93.7	15	93.7	8	50	7	43.7	5	31.2	1	6.2	0		0		2	12.5
III Malignant testis tumor	I	2	1		1		1		0		0		0		1		0		1	
	A	2	1		1		1		0		0		0		0		0		1	

\*I—inguen  
A—abdomen

cell type is encouraged by scrotal residence. The former explanation receives support from the available data, but the latter viewpoint is discussed further under the section dealing with pathology.

The point to be emphasized is that carcinogenesis does not seem to be hastened in ectopic testicles, a fact which suggests strongly that a tumor appears in its own inherent manner irrespective of its site. This is apparently so, unless involved assumptions be made such as the following (1) that ectopy by increasing the incidence of cancer above that found in scrotal testes introduces cases which have a later age of onset, or (2) that ectopy exerts a slow but persistent influence that causes a delay yet nevertheless increases the occurrence of cancer.

Finally, the tendency toward testis cancer may be better correlated with congenital con-

ditions than with residence in ectopy. The number of congenital abnormalities in patients with testis tumors is large. Ectopy *per se* is congenital. The incidence of congenital and potential hernia is very high (compare with the section applying to hernias), and pseudohermaphroditism was reported in 11 per cent of the 345 patients with malignant abdominal ectopies.

*Differential incidence of tumors in various sites of ectopy.* Restrictions must be observed in selection of the data. For an analysis of the relative incidence of non-cancerous ectopy in different sites, data should be secured that refers to only true cryptorchidism and excludes intermittently retracted testicles. The latter do not belong in the same category with the permanently ectopic organ, for the spastically retained testis resides in the scrotum from time to time, and may become perma-

TABLE IV—NO PARTICULAR TYPE FAVORS BILATERAL OCCURRENCE OF TUMORS

Bilateral tumors	Unicellular		Teratoid			Malignant testis tumors		Miscellaneous testis tumors		Total
			Teratomas		Chorion epitheliomas					
	Number	Per cent	Number	Per cent		Number	Per cent	Number	Per cent	
Both ectopic	13	56.5	5	21.7	0	2	8.7	3	13	23
Both scrotal	67	57.3	21	17.9	0	9	7.7	20	17.1	117
One ectopic, one scrotal	2	66.7	1	33.3	0	0		0		3
No data available	1	20	0		0	4	80	0		5
Total	83	56.1	27	18.2	0	15	10.1	23	15.5	148

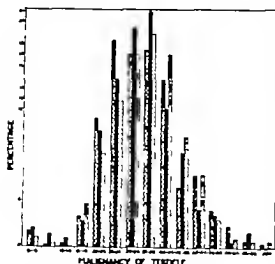


Fig. 5. \ one ectopic site or ectopy per se seems to hasten tumorigenesis. Instead, tumors in ectopic testes are recognized at later date (age of the patient listed in the brackets in 5 year groupings) than in scrotal testes. The graph is based upon data of 65 men with cancer in cryptorchid testes (247 abdominal, 35 inguinal) 690 men with cancer in scrotal testes. Black areas, abdomen; cross hatch scrotum diagonal lines, inguen.

nently scrotal at about puberty. Unless careful and adequate precautions are observed in diagnosis, spastic retraction may be mistaken for cryptorchidism. For example, of 16 cases referred to one of the authors by pediatricians, urologists, and others familiar with this condition in children 10 were instances of false cryptorchidism (31). The literature contains many reports of endocrine cures of cryptorchidism which were obtained in from a few hours to 3 days. If testis descent be assumed to necessitate lengthening of one or more structures of the spermatic cord the imagination would be severely taxed to comprehend its amazing rapidity. This growth of some inches would have to be accomplished with a rapidity that puts to shame the most malignant of tumors.

Obviously then, when data pertaining to the incidence of various types of ectopy are gathered from the statements of scores of men working independently there is the liability of inclusion of false cryptorchidism, a possibility enhanced by the fact that the majority of the cases reported are prepubertal and thus of an age at which spastic retraction is

common. We feel that the figures given by many authors for the incidence of inguinal cryptorchidism are probably much too large and further that testes that are not palpable should not be classified as abdominal as they may be absent in some abnormal place like the thigh or in the case of small testes even overlooked. The data of ectopy to be discussed were collected from *surgical cases only* which by allowing an opportunity for locating the testicle exactly may be less liable to inclusion of spastic retention. As far as permitted by the written records, each individual case was read critically and discarded if the testes were pubic, high scrotal, occasionally retracted, not located, or described equivocally. Thus the figures are seldom those given by the authors (Table I).

The data pertaining to testis cancer are preponderantly of postpubertal males and consequently less subject to confusion with false ectopy than those of non-cancerous cryptorchidism.

*Analysis.* Inasmuch as ectopy per se has not been proved to be causative of malignancy it is illogical to expect that any particular site of ectopy promotes carcinogenesis. Since ectopy is associated with malignancy however the various sites of ectopic malignancy were examined for any possible differential incidence. Such reckoning must be made not from the average incidence of cancer in different sites but with reference to the percentage incidence of testicular ectopy in the different sites. Obviously, if ectopy is more common in the inguen than in the abdomen, there would be greater opportunity for inguinal than for abdominal tumors.

*Inguen versus abdomen.* The significance of the site of the malignant cryptorchid testis may be judged wrongly from a superficial appraisal of 490 tumors in the inguen 345 in the abdomen (Table I). Although tumors are more common in inguinal than in abdominal testes it would be an erroneous conclusion to state on this basis alone that inguinal more than abdominal cryptorchidism is predisposed to malignancy. In fact, when the incidence of testicular tumors in the abdomen and inguen is compared with the incidence of ectopic testicles in these locations

# GILBERT AND HAMILTON TUMORS IN ECTOPIC TESTES

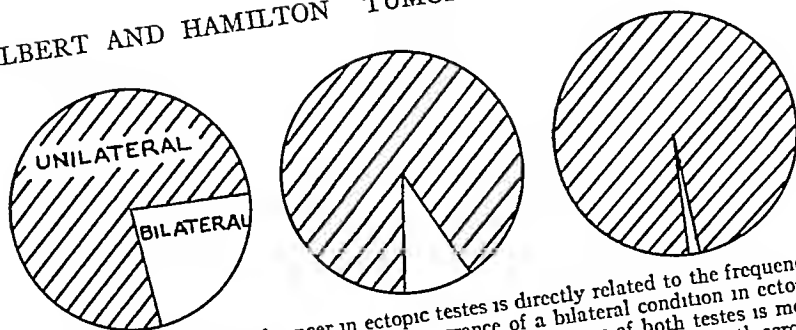


Fig 4 The incidence of cancer in ectopic testes is directly related to the frequency of cryptorchidism. Thus, the common occurrence of a bilateral condition in ectopy (290 of 12,885 cases, 22.6 per cent) is reflected in that cancer of both testes is more common in cryptorchid men (79 of 801 cases, 9.9 per cent) than in those with scrotal (60 of 6,200 cases, 1.0 per cent) testes

(Table I), it appears that there is a relatively higher incidence of cancer in testes retained in the abdomen than in the inguen. It is necessary to regard with skepticism, however, some of the data upon which is based the frequency of abdominal versus inguinal sites in non-malignant cryptorchidism. Even among surgical cases faulty diagnosis may result in the inclusion of cases of spastic retraction of the testicle, in which the testis is usually withdrawn not to the abdomen but only to the inguen or puboscrotal region. The data of ectopy would be more reliable if special precautions were taken in diagnosis (21), or if it were possible to include only males past puberty. Even so there might be appreciable errors if, for example, operative inspection is more frequent in inguinal than in abdominal ectopy, because, perhaps, of a differential incidence of hernia.

Even the hand-picked data in Table I reveal chiefly a lack of reliability concerning the incidence of abdominal cryptorchidism. The shortcomings of this data must be kept strictly in mind during any attempt to theo-

size that the temperature of the abdomen or traumatic exposure in the inguen would be more conducive to carcinogenesis.

*Unilateral versus bilateral* Unilateral malignancies form 90.1 per cent of all cases of cancer in ectopic testicles, unilateral cryptorchidism approximately 77.4 per cent of all ectopies (Fig 4). Bilateral malignancies constitute 9.9 per cent of all ectopic testicular tumors, bilateral ectopies 22.6 per cent of all ectopies. Figure 4 shows in convincing fashion that the high incidence of double primary cancer in ectopic testes is related to the high incidence of bilateral ectopy.

*Right versus left sides* Inguinal The right testis is more frequently the site of cancer than the left. But in non-malignant inguinal cryptorchidism the right side is similarly more frequently involved than the left side (Fig 5). The higher incidence of right inguinal malignancy is to be correlated simply with a greater proportion of right inguinal ectopy. The data regarding the incidence of right and left sides in abdominal ectopy are scarcely extensive enough to permit analysis.

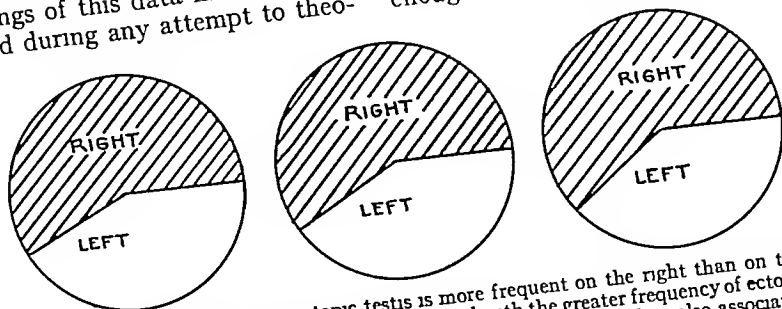


Fig 5 Malignancy in the ectopic testis is more frequent on the right than on the left side (157 right, 114 left), apparently correlated with the greater frequency of ectopy on the right side (402 right, 297 left). Indirect inguinal hernia which is also associated with cryptorchidism is similarly more frequent on the right side.

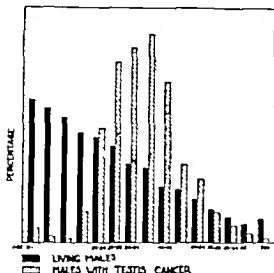


Fig. 6. The occurrence of testicular tumors is in the period of reproductive activity. There appear to be two peaks in the incidence of the tumors, minor one shortly after birth that may stem from congenital or prenatal conditions, and a major increase in incidence that coincides with sexual maturity. The greatest incidence is found in men of 25 to 39 years.

#### CORRELATION BETWEEN TESTIS TUMORS AND REPRODUCTIVE ACTIVITY

There appear to be two periods of life when the occurrence of testis tumors is accentuated (Fig. 6). The first is shortly after birth and may represent either a congenital condition or one that possibly results from the high titers of hormone substances that are known to cause development of the testes and the secretion of androgenic material in the newborn. Then follows the period from 5 to 14 years inclusive which is one of very limited tumor production. During puberty and adult life there is a rapidly mounting increase in the incidence of testis cancer that reaches a peak from the thirty fifth to the thirty ninth year. After the sixtieth year the incidence becomes low.

The true picture is obtained by comparison of the incidence of testis cancer at various ages with the number of living males in these age groups. Part of the data in Figure 6 has been taken from statistics compiled by the United States Bureau of Census. An average is taken of reports from 1850 to 1930 to cover roughly the years during which most of the

cases of testis tumors were reported. It is realized that the cases of testis cancer are from the world in general and that the percentage of males in various age groups living in the United States is different from that of the world population. Nevertheless certain conclusions from the assembled data are inescapable. Not until the twentieth to twenty-fourth year age group is the percentage incidence of cancer in excess of the percentage of normal adult males in the age grouping. From this period on the percentage incidence of testis cancer remains materially higher than chance expectation until after the age group of fifty fifth to fifty ninth years. From the twenty fifth to the fifty ninth year groupings inclusive, the percentage incidence of testis cancer is about double and during the thirty fifth to thirty ninth years almost triple that expected by chance visitation in living males. After the sixtieth year period the percentage incidence of cancer is lower than the percent age of males living at this age. If assumptions could be made that testis cancer were noted and reported as efficiently in old as in young men and if the percentage of men living to an old age were as great in the United States as in the general world population, the suggestion would be that testis cancer is relatively less frequent after 60 years of age.

This correlation of tumor production with the period of hormone stimulation of the testis is in agreement with animal experimentation. Michalowsky reported that injection of the fowl testis with zinc chloride had a carcinogenic effect only in the spring when the gonads undergo marked development. Bagg, utilizing the same methods obtained results on the basis of which he suggested that an alkaline extract of anterior pituitary gland of the sheep may augment carcinogenesis in the testis injected with zinc chloride. Further confirmation of Michalowsky's studies is given by Anisimova, and by Falin and Gromozova.

It is of further interest to note that the period of from 35 to 39 years of age is the one in which men seem to show the greatest effects from castration, a fact which may perhaps be indirectly concerned with the high titer of gonadotropic substance produced during these

years and possibly in some fashion with the great incidence of testis tumors in men at this age

Curiously the highest incidence of testis cancer occurs at the time of greatest hormone production, whereas the highest incidence of cancer in the accessory reproductive organs, in contrast to that of the gonads, is during the years of declining gonad function. Continuation of this line of thought is engaging but beyond the scope of this paper

#### OTHER CONGENITAL DEFECTS AND TESTIS TUMORS

*Hernia* No attempt is made to study the significance of any correlation between inguinal hernia and malignancy of ectopic testicles. The data regarding frequency of hernia accompanying even non-malignant cryptorchidism is as variable as the individual investigator. Surgeons report an incidence many times greater than the general practitioner, in part because of the type of patients referred to them, and in part because of opportunities during operative inspection for the detection of small potential hernias. Of reported cases of ectopic malignancy an accompanying hernia was described in 9.6 per cent. The practical points to be considered are that ectopy is commonly accompanied by actual or potential hernia, that surgical transfer of the ectopic testicle permits inspection and repair of this condition, placement of the testicle in the scrotum, and a better opportunity for spermatogenesis, hormone secretion, and observation of any malignant change.

Many authors stress the fact that trusses were worn by the men (16 cases) who developed malignancy of ectopic testicles. Wearing of a truss may add a factor of chronic trauma, but any such relation is a matter that cannot be proved conclusively, or with the present facts entirely disproved. The presence of hernia is additional evidence of the congenital defects which accompany ectopy.

*Pseudohermaphroditism* Even casual inspection of the patients with testis cancer reveals the large number of pseudohermaphroditic individuals. Hypospadias and many varieties of from inconspicuous to fairly well

formed rudimentary female portions of the reproductive tract are commonly reported. Of 345 patients with an abdominal testicular tumor 11 per cent were pseudohermaphroditic. In patients with testis cancer, congenital defects associated with other than the reproductive organs included such matters as cleft palate, hair lip, but were not as common as hernia, pseudohermaphroditism, and ectopy.

#### ORCHIDOPEXY AND TESTICULAR TUMORS

A question often raised as to management of cryptorchidism is whether or not orchidopexy lowers the incidence of testicular malignancy. Little utility other than allowing easy inspection is served by operative placement in the scrotum of the testicles that later become malignant. The above data would not indicate that the ectopic position induced malignancy. This viewpoint is strengthened by the fact that orchidopexy has not prevented latent malignancy in 77 cases. Undoubtedly in a certain number of patients a tumor may have been fixed in the scrotum, so that testes which appeared normal at the time of operation were actually the site of malignant change at that time. It would seem more probable, however, that many of the testicles that showed malignancy some years after placement in the scrotum, had been neither tumorous at the time of operation nor subject to cancer because of an ectopic location.

It might seem suggestive that over half of the number of tumors reported to occur in ectopic testicles following placement of the testicles in the scrotum were classified as unicellular tumors. Since the seminiferous tubules show complete spermatogenesis only in sites like the scrotum, spermatogenic activity might be expected to be augmented by fixation of the ectopic testis in the scrotum. Comparison of the incidence of various tumor types in ectopic and scrotal testes (Table II) does not support claims for a higher incidence of seminomas in scrotal than in ectopic testes. The fact to be stressed is that concern about the ectopic testis does not end following the successful placement of the organ in the scrotum. Careful management would seem to suggest the observation of the patient at regular intervals thereafter.



No figures of the incidence of cancer in testes surgically placed in the scrotum are available for comparison with the incidence in testes not operated upon or in scrotal testes. Seventy seven cases may be said to be relatively few and results of orchidopexy have been in the main free from malignant complication. But until more specific data are available there can be no foundation for any assumption that orchidopexy may lower the incidence of malignancy. The rationale for orchidopexy must rest upon the placement of testicles where they can be more closely observed, the repair of hernias that commonly accompany cryptorchidism and the encouragement of spermatogenesis, possibly also of increased hormone secretion.

Placement in the abdomen of testes which were seemingly impossible to put in the scrotum has been followed in 14 cases by reports of tumors. Such occurrences in testes resident in the abdomen make surgical judgment in the individual case a choice between the danger of carcinogenesis and the benefits to be obtained from hormone secretion of the testis; spermatogenesis can scarcely be expected in abdominal testes.

#### **PATHOLOGICAL TYPE OF TUMORS WITH THE CLINICAL HISTORY OF PATIENTS WITH EC TOPIC AS CONTRASTED WITH NON EC TOPIC TESTIS TUMORS**

*General.* Inspection of pathological nomenclature as applied to testis tumors discloses at once a great variation in terms. This is apparent in printed reports and is even more obvious when such tumors are discussed at meetings of pathologists. Many reports in the literature can be interpreted only by a simple classification, which divides the cases into uncellular or mixed tumors, irrespective of the long and often complicated terminology employed by the author. These two types comprise the bulk of all testicular tumors. Unfortunately a high percentage of available records give no histological details or fail to include photomicrographs; to these only the designation of malignant testis tumors

can be applied. Another general group listed as "miscellaneous," includes descriptions of occasional and rare tumors.

A total of 840 tumors in ectopic testes are discussed under necessarily broad terms. The cases are divided into 3 groups, those found in the inguen 483 cases in the abdomen, 307 cases and in pseudohermaphroditic individuals, 50 cases. Examination is also made of 701 cases of cancer in scrotal testes for purposes of comparison.

Clinically the patients were classified in 3 groups, (1) primary operable (2) primary inoperable in which surgery was performed in the presence of metastases and (3) without surgical intervention.

To conserve space the details of these data are presented in Table II.

*Age of recognition of tumor types.* In the uncellular type the age at recognition of the tumor is essentially the same in ectopic and in scrotal sites. Teratomas in the scrotum are recognized early, however, some 6 years before those which are located in the inguen, and 8 years before those in the abdomen.

*Clinical grades.* Abdominal tumors of all pathological types have a higher percentage (83 per cent) of inoperable cases than those in the inguen or scrotum. This is to be expected because of the anatomical location. The high incidence of cancer in abdominally located testes, in comparison with the incidence of abdominal ectopy in general, should cast grave suspicion upon patients with abdominal tumor masses and abdominally retained testes.

*Pathological types.* The percentage incidence of uncellular tumors does not vary with the position of the testis, but teratoid tumors are two times more common in a scrotal than in an ectopic position. No particular pathological type appears to predispose toward bilateral testicular tumors (Table IV).

Because the so called "malignant testis tumors" are unclassified and the miscellaneous ones few, no attempt is made to analyze them.

As to the location of non-cancerous testes in patients with a unilateral ectopic tumor the non-tumorous testis is commonly either in a corresponding ectopic position or in the scrotum.

It is probably true that roughly the same percentage of uncellular and mixed tumors exists in the miscellaneous group as in the lower 3 groups of uncellular and mixed tumors, the primary clinical data and the prominence of clinical or autopsy examinations leave no doubt as to their malignancy.

*Pre-operative duration* In patients with abdominal tumors the duration of life is 30 per cent shorter, with inguinal tumors 15 per cent shorter, than in men with tumors of scrotal testes. This appears to be directly related to the high percentage of inoperable cases in ectopic tumors as previously noted, indicating a greater likelihood of metastatic involvement prior to recognition and operation.

*Total duration of fatal cases* Early diagnosis is highly important in men with scrotal tumors, but, in those with ectopic tumors what is called "early diagnosis" does not seem to have resulted in longer survival. This is true in all tumor types, the average length of life in cases with ectopic tumors being 30 to 60 per cent shorter in those with non-ectopic tumors. The frequency of metastases, as determined at autopsy, is listed in Table III.

*Survivals For 3 years* In men with unicellular testis tumors the chance of survival is 50 per cent less in those in which the testis is ectopic rather than scrotal. In the men with teratoma of an ectopic testis the chance of survival is even less, only from 50 to 65 per cent of that of men with a corresponding tumor in the scrotum. There is no report of a patient with a verified chorionepithelioma in an ectopic testis who survived for 3 or more years.

*For 5 years* In this group the men with unicellular tumors in ectopic testes had from a 40 to 75 per cent shorter survival time than men with similar tumors in scrotal testes. As in the group of 3 year survivals, the patients with teratomas in ectopic testes lived only from 65 to 85 per cent as long as those with this type of tumor in scrotal testes.

#### CONCLUSIONS

In view of the significance of the correlation between testicular cancer and ectopy, a reasonably complete collection of testis cancer reports has been made. The analysis of 841 cases brings out the following points:

1 Among males in the United States whose deaths are attributed to cancer, testicular cancer accounts for 0.6 per cent. The incidence of testicular tumors in males living in the United States may be estimated at 0.0013 per cent.

2 Patients with cancer of the testis commonly exhibit congenital defects, such as ectopy, hernia, and pseudohermaphroditism.

3 Cancer of the testis is associated with ectopy as follows: (a) In 11 per cent of recorded cases of testis cancer there is concomitant ectopy, a correlation 48 times higher than expected by chance association. (b) In the patient with cancer of one testis and unilateral cryptorchidism, 97.5 per cent of the tumors are in the ectopic testis. (c) Of bilaterally cryptorchid men with one testis cancer 24.6 per cent of the patients developed a tumor in the second testis, whereas men with both testes in the scrotum developed a second testis tumor in but 1 per cent of the cases. The frequency of bilateral involvement of ectopic testes is 32 times that of scrotal testes. (d) Two rare cases are reported of cancer of a supernumerary ectopic testis while the normally descended testes of the men are not involved.

4 Ectopy is not necessarily the cause of cancer. (a) Cancer appears at an earlier average age in patients with scrotal than with ectopic testes, 31 as compared to 34 years, it does not appear that ectopy hastens carcinogenesis. (b) A tumor occurred in the descended but not in the undescended testis of 23 patients with unilateral cryptorchidism. (c) No particular tumor type is favored by an ectopic site. (d) The predisposition to testis cancer can be better correlated with congenital conditions than with an ectopic site.

5 A high incidence of cancer in certain ectopic sites may be related to the frequency of ectopy in these sites. The data do not prove beyond reasonable doubt that there is any enhancement of carcinogenesis by a special position.

6 The incidence of testis cancer is highest during reproductive life, being markedly greater from puberty until about the sixtieth year, reaching a peak in the thirty-fifth to thirty-ninth years. This fact is true not only with regard to the percentage incidence of testis cancer in the various age groups but also with regard to the number of living males in these age groups. Between the twenty-fifth and the fifty-ninth year groupings the percentage incidence is almost double and

during the thirty fifth to thirty-ninth years almost triple that expected by chance visitation in living males. Animal experimentation and other facts suggest that the marked hormone stimulation of the testis during these years is an important factor in the production of cancer of the testis.

7 *Management.* (a) The clinical history and prognosis in different types of testis cancer are discussed. The undescended testis must be regarded from the viewpoints of potential malignancy and as an organ unfavorably situated for spermatogenesis but conducive to herniation. Orchidopexy is not the complete answer for 77 tumors have been observed in testes previously transferred to the scrotum from an ectopic position. Careful management would include observation of the testis after orchidopexy and careful evaluation of the benefits and possible dangers of testes surgically returned to the abdomen. (b) The incidence of cancer in the second testis (following involvement of one testis) is approximately one in a hundred men whose testes are scrotal, almost one in four in men with bilateral cryptorchidism. These facts direct attention upon the second testis when one testis is known to be malignant and are equivalent to ordering continued observation in patients with ectopy. (c) Even in men who are not cryptorchid the possibility of involvement of the second testis after the occurrence of cancer in one testis is a matter of import for the frequency of bilateral tumors is some 770 times the incidence of cancer in either testis of the general male population.

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# ESTROGEN THERAPY OF THE CLIMACTERIC

## An Analysis of Seventy-Seven Personal Cases

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**R**ELIANCE upon the control of subjective symptoms as a test of therapy is never entirely satisfactory in any disease. It is particularly unsatisfactory in the management of such a condition as the menopausal syndrome in which emotional and psychic factors play so important a part. The first real advance in the therapy of this syndrome came with the development of potent standardized hormonal preparations. The effect of hormonal therapy however still had to be gauged, in large part, by the patient's own opinion of her own state and dosage and duration of treatment remained largely empirical.

In 1933 Papanicolaou (3) demonstrated in the vaginal epithelium cyclic changes comparable to the similar cyclic changes which occur in the endometrium during menstrual life and after the menopause. Three years later with Short (4) he showed further that characteristic changes occur in the vaginal epithelium during the menopause after the administration of estrogen the changes being in complete correspondence with the improvement in clinical symptoms. Since the making of vaginal smears is a practical and extremely simple procedure Papanicolaou's work has furnished a means of controlling, objectively the hormonal therapy of the menopausal syndrome.

In the postmenopausal period the vaginal smear (Fig. 1) ordinarily shows round or oval squamous epithelial cells. The nuclei are well preserved and stain deeply and there are many polymorphonuclear leucocytes, with a few erythrocytes. In the normal menstrual cycle at the tenth or twelfth day (Fig. 2) the vaginal smear shows large flat squamous epithelial cells with pyknotic nuclei. Many of the cells are cornified and leucopenia is char-

acteristic. This same picture is seen in the vaginal smear of a patient in the menopausal period who has been adequately treated with estrogen (Fig. 3).

During the 4 year period ending January 1, 1940, I have personally treated 77 patients for symptoms referable to the climacteric or menopause. Sixty of the group were treated by estrogen therapy the dosage and duration of which were controlled by repeated studies of vaginal smears.

Of the 58 patients who were undergoing the natural menopause 33 had already ceased to menstruate. The age range was from 38 to 50.8 years, the average age being 44.4 years. Nineteen patients were suffering from the symptoms of an artificial menopause in 15 cases the result of surgery and in 4 the result of radium. The age range in this group was from 30 to 48 years, with an average age of 39 years. The age range in the surgical group was from 30 to 39 years, and in the irradiation group from 39 to 48 years.

### GENERAL CONSIDERATIONS

Whether symptoms are due to the natural menopause which is usually gradual or to an acquired menopause which is practically always abrupt, is an important consideration. Symptoms of the acquired menopause are always more difficult to control, and are apt to be more severe than in patients undergoing the natural menopause because they usually occur at a considerably earlier age.

Routine hormonal therapy for the menopausal syndrome is entirely irrational. It is needed in the majority of patients who present symptoms, it is true particularly if the menopause has been artificially induced. But a definite proportion of such women need only general measures which in some instances amount to little more than suggestive therapy.

From the Department of Obstetrics and Gynecology of the School of Medicine of Louisiana State University.  
Read before the Louisiana Gynecological and Obstetrical Society at the annual meeting in New Orleans, April 26, 1940.

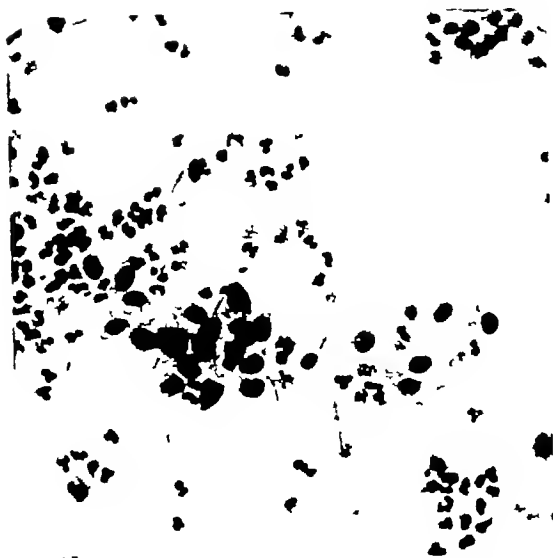


Fig 1 Case 2 Vaginal smear, menopausal type, prior to treatment. X67

The fact that 17 of the 77 women in this series needed only constitutional treatment demonstrates further that one's enthusiasm for the results of hormonal therapy must not blind one to what can be achieved without it. This is an important consideration in several respects, not the least of which is the cost of endocrine preparations. The expense of such treatment, to many patients, is almost if not entirely prohibitive. It is significant, however, that although constitutional management was sufficient in 13 of the 58 patients undergoing the natural menopause, it succeeded in only 4 of the 19 patients undergoing the artificial menopause.

When a patient who complains of menopausal symptoms is first seen, a careful history should be taken, a complete physical and pelvic examination made, and such laboratory procedures undertaken as may be indicated. It is quite possible that the patient may have symptoms referable to some part of the body other than the pelvis or the endocrine system. Women in the middle years are frequently anemic or hypothyroid. Their symptoms may be due, wholly or in part to such conditions as psychoneuroses, cardiorenal or cardiovascular disease, hypertension or thyroid states. Vaginal smears are useful in ruling out such



Fig 2 Vaginal smear, follicular phase, at tenth to twelfth day of menstrual cycle in a normal woman X425

conditions. Many patients suffer from improper diet, constipation, lack of exercise, and generally unhygienic habits of life. Nervousness and depression, in the absence of physical causes, can often be corrected by such simple measures as a change in the daily routine, or the introduction of some type of diversion, even without the additional use of phenobarbital, bromides, or even calcium.

It cannot be too strongly emphasized that one of the most important of the physician's duties is to make certain, by repeated pelvic examinations, that malignancy is not present and is not developing in patients under his care. This is the time of life in which cervical malignancy, as well as other types, is most frequent. The experience of many clinics has shown that both the incidence and the mortality of malignant disease can be reduced by the correction of predisposing conditions, particularly cervical erosions and infections, and the prompt diagnosis of malignant disease in menopausal years. The physician observing such patients over long periods has a real chance to practice preventive medicine.

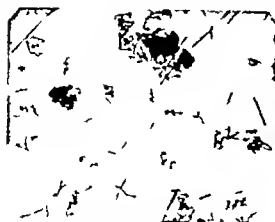


Fig. 3 Case. Vaginal smear menopausal type after full effect of estrogen has been attained. Compare with Figure 1, prior to treatment, and Figure 4, before adequate estrogen therapy has been given.  $\times 60$ .



Fig. 4 Case. Vaginal smear menopausal type after treatment with estrogen has been begun but is not yet adequate. Compare with Figures 1 and 3.  $\times 115$ .

It is not possible regardless of the method of treatment to ignore the emotional and psychic factors of the climacteric. While some women look forward to the period of life when the recurrent discomforts of menstruation and the dangers and inconveniences of child bearing are over to others the middle years are a critical and dangerous time. In such subjects emotional instability may develop into a real psychosis. It must be part of the physician's duties therefore to reassure his patients and to persuade them that neither their health nor their psyche will suffer during this period if they will follow his directions as to hygienic habits and substitutional therapy.

#### HORMONAL THERAPY

The hormonal preparations used in these 60 patients included estrol (thebol) for oral use and estradiol benzoate (progynon B) and estrone (amnothin, theelin) for hypodermic use. The dosage was predicated upon the intensity of symptoms which were classified as mild, moderate, and severe. In mild cases the therapy consisted of 2,000 to 4,000 international units by mouth daily in single or divided doses. In moderately severe cases a single daily dose of 2,000 to 5,000 international units was administered by hypodermic. In severe cases a single daily dose of 4,000 to 10,000 international units was administered also by the hypodermic route. In some in-

stances the dosage had to be somewhat larger and the combined oral and hypodermic routes were used. Although some observers (2) have reported satisfactory results in moderately severe and severe cases with large doses of estrogen given every 3 or 4 days, I have had better results by more intensive therapy. It is my practice to continue intensive daily treatment in mild cases for 1 to 2 months, in moderately severe cases for 2 to 3 months, and in severe cases for 4 to 5 months. Oral treatment is continued for several weeks thereafter according to the indications.

Generally speaking, most patients show signs of clinical improvement irrespective of the method of administration if the dosage of estrogen is adequate. That point can be determined not only by the improvement of subjective symptoms but by the examination of repeated vaginal smears. The change from the degenerative or menopausal stage (Fig. 1) to the follicular stage (Fig. 3) usually occurs within 2 to 4 week after adequate therapy has been instituted. After symptoms have been relieved and the follicular stage has been maintained for several weeks the dosage is

## CASE 2 MODERATE SEVERE

Name Mrs M P Address \_\_\_\_\_  
 Age 43

1939

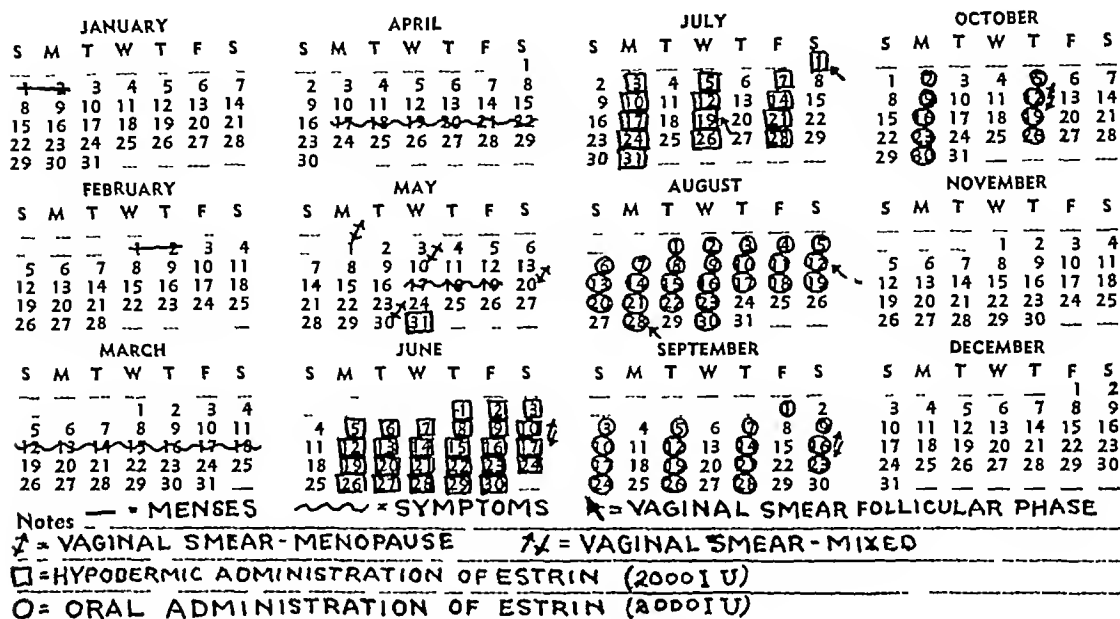


Fig. 5 Estrogenic therapy for moderately severe menopausal symptoms, checked by vaginal smears, Case 2

(Figs. 1, 3 and 4) This is a very convenient method of keeping office records

gradually reduced as the condition of the patient warrants. Too brief a period of treatment is likely to be followed by recurrence of symptoms.

Once the follicular stage has been attained and symptoms have been relieved, it is frequently possible to reduce the dose to the point at which the mixed or grouped stage of vaginal epithelium is maintained (Fig. 4). For the proper interpretation of therapeutic results some sort of pattern is necessary. It is well, therefore, before the institution of treatment, to make vaginal smears at intervals of 10 to 12 days for a month or more, during which time the effect of constitutional measures alone can be gauged.

The changes which occur in the vaginal smear following adequate estrogenic therapy are definite (Fig. 3). If they do not occur, it may be assumed that the size of the dose is inadequate, and it should be increased until

the follicular, or at least the mixed stage, is brought about and maintained. It is equally important, on the other hand, to reduce the size of the dose as soon as subsequent smears have shown that this can safely be done. As has been pointed out already, the economic aspects of endocrine therapy cannot be ignored in the average case.

## CASE REPORTS

Three case histories will serve to illustrate both the technique and the results of this type of therapy.

CASE 1 Mrs. C. M., 38 years of age, had begun to show signs of ovarian failure, as evidenced by scanty and infrequent menstruation and nervous symptoms, for several months before she was first seen May 30, 1939. A vaginal smear on that date showed the follicular (preovulatory) phase and a second smear June 6 the postovulatory phase of the monthly cycle. Complete abdominal hysterectomy was performed July 15, for a uterocervicovaginal



Artula, for which three previous attempts at surgery had failed. Estrogen was first administered July 7 and was continued tentatively until September 3. Maintenance doses were then given until November 5. A persistent follicular phase as observed in the vaginal smears August 1, August 3, and September 3. The patient's symptoms, which it should be noted had been present prior to hysterectomy, disappeared soon after treatment was begun, and recovery has been complete and permanent.

**CASE 5.** (Fig. 5) Mrs. M. P., 43 years of age, had had menstrual periods lasting for only 2 days each for the 2 years prior to February 1939, when menstruation had ceased abruptly. Moderately severe menopausal symptoms were present March 1, 8, and again April 7. She presented herself for treatment May 1, 3 months after the last menstrual bleeding had occurred.

Vaginal smears May 1, May 6, May 20, and May 30, were all typical of the postmenopausal period (Fig. 4). The administration of estrogenic substance was begun May 30. June 6 the vaginal smear (Fig. 4) showed a moderate effect of the therapy. The typical follicular type of smear illustrating the full effect of estrogen, was obtained June 20 (Fig. 5) and persisted throughout July and August. During this period large doses of estrogen were given. During September and October the intervals of oral administration were lengthened, first to every second and then to every third day. The mixed type of smear was obtained September 16 and October 2. Although the patient was relieved of her symptoms shortly after estrogenic therapy was instituted, the entire period of treatment covered 5 months.

**CASE 3.** Mrs. R. N., 47 years of age, had had scanty menstrual periods, lasting not more than 2 days each, during May, June and July 1939. Menopausal symptoms are severe and at times were definitely psychotic in character. She was first seen July 8, on which date vaginal smears showed the follicular phase. The vaginal smear August 2 showed the postovulatory phase. With the institution of appropriate estrogenic therapy mixed smear was obtained August 3 and again September 6, and the follicular phase as observed in the smears of September 5, October 4, and November. The intervals of administration were then lengthened, and the vaginal smears December 8 and thereafter were of the mixed type. The entire period of therapy covered 7 months.

Although symptoms were very severe they disappeared completely after September 6, when the vaginal smear was first of the mixed type. The typical postmenopausal smear was never observed in this case because there was some persistence of ovarian function. The sharp contrast in the vaginal smears which is usually seen before and after estrogen was therefore never noted. Treatment was discontinued for 3 or 4 days prior to each menstrual period because of the occasional tendency of estrogen

in large doses at such times to produce excessive uterine bleeding and even aggravate menopausal symptoms.

These 3 case histories illustrate respectively the effect of estrogen therapy checked by repeated examinations of vaginal smears in patients with mild, moderately severe and severe menopausal symptoms.

## RESULTS

The results in the 60 cases thus treated may be tabulated as follows:

Forty-two patients, 70 per cent, had excellent results with a single course of treatment.

Thirteen patients, 21.7 per cent, had good results with one course of treatment but needed at least one additional course.

Five patients, 8.3 per cent, had only fair results with the first course of treatment and needed several additional courses for complete relief.

No patient in the series failed to respond in some way to a single course of estrogen therapy, but the results were not entirely satisfactory or there was a recurrence of symptoms, in 18 instances, 30 per cent of the total number. It is significant that only three patients in this group had symptoms referable to a natural menopause. Eleven had had a surgical and four a post irradiation menopause which means that 15 of the 19 patients in the artificial menopause group did not respond immediately to estrogen therapy. Larger therapeutic and maintenance doses were given and treatment was carried on over a longer period in these cases but the results of the first courses of treatment were still less satisfactory than in the natural menopause group.

I have now demonstrated to my own satisfaction that the best plan of treatment in such cases is prophylactic. The patient who is to be submitted to radical pelvic surgery or to irradiation therapy is given small prophylactic doses of estrogen by mouth (2,000 to 4,000 international units) for several weeks before the procedure is to be undertaken and the same dosage is continued for a prolonged period of time afterward. Vaginal smears are made at regular intervals to be certain that the follicular phase has been achieved and is

being maintained. By this method I have had exceedingly satisfactory results in a small group of patients whom I saw early enough to make prophylactic therapy possible.

#### SUMMARY AND CONCLUSIONS

1. A series is reported of 77 patients with symptoms referable to the natural or artificial menopause who were treated by a combination of constitutional and hormonal therapy.

2. Standardized estrogenic preparations were administered by the oral, hypodermic, or combined routes in dosages primarily dependent upon whether symptoms were mild, moderately severe, or severe.

3. Repeated vaginal smears were used as a diagnostic measure and as a guide to therapy, the change from the degenerative to the follicular type of smear indicating the full therapeutic effect of the estrogen. The alteration in the smear practically always parallels symptomatic improvement.

4. Adequate, frequent doses of estrogen must be given over a protracted period of time after clinical symptoms have been relieved in order to insure complete and permanent recovery. Clinical improvement should be checked by repeated vaginal smears.

5. Relief of symptoms ensued after a single course of treatment in 42 of the 60 patients in

whom estrogen therapy was employed. Fifteen of the 18 unsatisfactory results or recurrences after the first course of treatment were in the group of patients who had had an artificial menopause due either to surgery or to irradiation. Prophylactic administration of estrogen is of very definite value in such cases.

6. A certain group of patients with menopausal symptoms need only constitutional and hygienic measures for relief. The emotional and psychic factors play an important part in many of these cases, and the detection and correction of pathological processes, particularly of malignant processes, is an essential feature of their management. Endocrine therapy should not be employed until it is clear that simpler measures will not be effective.

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# BENIGN AND MALIGNANT CYSTIC TUMORS OF THE APPENDIX

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THIS paper is based on a clinical and pathological study of a group of cystic tumors of the appendix which previously have been included under such terms as "mucocele," cystadenoma, and mucoid cyst. These tumors are made up of cystic dilatations of the appendix which contain mucoid material. They are generally known as mucoceles.\* We have separated these mucoceles histologically into two groups: (1) those which contain adenocarcinoma, grade 1, which we believe are responsible for the so called pseudomyxoma peritonei of appendiceal origin; and (2) plain or simple mucoceles which rather than being true tumors are cystic dilatations of the appendix associated with an overproduction of mucus. The malignant nature of pseudomyxoma peritonei of appendiceal origin has been repeatedly commented on in the literature, but we have not been able to find any reports in which mucoceles have been divided histologically into the relatively innocuous group which seem to result from obstruction of the lumen of the appendix, and the true malignant tumors which potentially may lead to diffuse pseudomyxoma peritonei and ultimately to death.

To obtain material for this study we have reviewed the histories of cases in which the appendix was removed at the Mayo Clinic between January 1, 1914 and June 30, 1938 inclusive. The histories and pathological specimens in all cases in which a diagnosis of mucocele, cystadenoma, or cyst of the appendix had been made were selected for this investigation. In the period mentioned appendectomy was performed in approximately 43,000 cases at the clinic. In 146 cases examination of the appendix disclosed either a so called mucocele or adenocarcinoma, grade

1, in a cyst. The incidence of cystic tumors in the appendices removed at the clinic in the stated period therefore was 0.3 per cent. This incidence agrees favorably with reports in the literature. Castle reported that the incidence of mucoceles of the appendix was 0.2 per cent in a series of 13,158 necropsies. Weaver reported that the incidence of mucoceles was 0.11 per cent in a series of 6,325 cases in which appendectomy was performed at the Holywood Hospital.

Mucocele of the appendix was first recognized as an entity by Rokitsansky in 1842, and it was again mentioned in 1863 by Virchow. Werth first described finding gelatinous material in the peritoneal cavity in 1884. This material proved to be pseudomucin rather than mucin and he called the condition pseudomyxoma peritonei and ascribed its origin as attributable to the rupture of a pseudomucinous cyst of the ovary with resultant implantation of the cystic contents on the peritoneal surface. Ferè was the first to apply the terms retention cyst, hydrope, and "mucocele" to that portion of the appendix in which dilatation had occurred. In 1901 Fraenkel first reported finding pseudomyxoma peritonei in a male patient at necropsy. In this case the condition was due to a ruptured cyst of the appendix. Oshausen probably gave the first correct idea as to the pathogenesis of pseudomyxoma peritonei. He expressed the opinion that the epithelial cells of the lining of the ruptured cyst were transplanted to the peritoneal surfaces, and that there they took root and continued to secrete gelatinous material.

In 1916 Dodge, after an exhaustive study, was able to find only 142 cases of mucocele of the appendix reported in the literature. In 1933 Pitts and Gee reported a case in which necropsy disclosed that pseudomyxoma peritonei was the result of a mucocele. They found extensive involvement of the abdominal cavity

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Manuscript of this paper submitted by one of us (Woodruff) to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery.



Fig 1

Fig 1 Wall of an early simple mucocoele. Note the apparent increase of mucous cells which is the differentiating point from normal appendiceal mucous membrane (hematoxylin and eosin,  $\times 25$ )



Fig 2

Fig 2 Mucocoele of the appendix. The wall is thinned



Fig 3

out and has lost practically all evidence of cellular structure (hematoxylin and eosin,  $\times 25$ )

Fig 3 Wall of a mucocoele of the appendix showing the presence of a single layer of mucous cells (hematoxylin and eosin,  $\times 25$ )

ity. The material in the peritoneum showed fine fibrous trabeculae enclosing masses of homogeneous amorphous material with scattered small aggregations of tall, uniform, columnar epithelial cells which were grossly adherent to all structures of the peritoneal cavity. In 1934, after a survey of the literature, D'Aunoy and Fine were led to believe that only 90 authentic cases of pseudomyxoma peritonei of appendiceal origin had been reported. They reported a case of their own. They felt that the condition was due to an inflammatory contracture in the lumen of the organ. In 1937, Weaver collected reports of 256 cases of mucocoele of the appendix either with or without the existence of pseudomyxoma peritonei, and reported a case of pseudomyxoma peritonei of appendiceal origin.

The gelatinous material found in this disease is generally accepted as being pseudomucin. Some authors have reported finding mucin in the cysts, but they are in the minority and their cases probably represent earlier stages of the disease. Norment studied the nature of the mucoid material in some cases. In each instance it took the stain for pseudomucin and gave a positive chemical reaction for the same substance.

#### CLINICOPATHOLOGIC CONSIDERATION

The 146 cases which form the basis of this report were divided into two groups according to the histological appearance of the cystic tumor. Group 1 includes 136 cases in which the tumor was classified as a simple mucocoele

Group 2 includes 10 cases in which the tumor was classified as an adenocarcinoma, grade 1, according to the method of Broders.

*Group 1 Etiology* Simple mucocoeles of the appendix occur at almost any age. In the 136 cases in this group the youngest patient was 4 years of age and the oldest patient was 70 years. The average age of the patients in this group was 42.3 years. The lesions appear to occur a little more frequently in the fourth, fifth, and sixth decades of life, that is, when persons are most likely to have to undergo an abdominal operation either for inflammation of the appendix or some other condition. It is our opinion that age, in itself, is not of any etiological significance.

Seventy-nine of the patients were females and 57 were males. The ratio of females to males, therefore, was 1.4.

The general conception is that mucocoeles of the appendix are the result of stricture of the lumen, which usually is caused by an inflammatory process. In practically all of the cases in this group examination of the appendix disclosed a definite stricture proximal to the mucocoele. In the absence of polymorphonuclear leucocytes, it is difficult to say that definite inflammation is present or has been present in the wall of the appendix. However, thickening and fibrosis of the wall are often evidence of an old inflammatory process, as is a history of attacks of pain and tenderness in the right lower quadrant of the abdomen.

In 75 cases polymorphonuclear leucocytes were present in the wall, or definite thickening



Fig. 4



Fig. 5

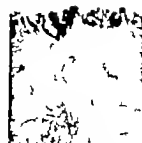


Fig. 6

Fig. 4. Adenocarcinoma, grade of appendiceal cyst wall. Not the characteristic papillary arrangement (hematoxylin and eosin  $\times 50$ ).

Fig. 5. Wall of appendiceal cyst containing adenocarcinoma, grade. The histological picture closely resembles

similar condition in ovary (hematoxylin and eosin  $\times 5$ ).

Fig. 6. Adenocarcinoma, grade. In the cyst all of an appendix. The tendency of the nuclei to extend up the length of the cells is all shown (hematoxylin and eosin  $\times 75$ ).

and fibrosis were present in the wall or the past history was very suggestive of appendicitis, or a combination of two or more of these findings was encountered. In many of the cases in this study the appendix was removed incidental to another operative procedure and no special attempt was made to obtain a history of appendicitis. It seems to us that this fact and the high incidence of rather definite indication of inflammation are strong evidence that inflammation is a very definite etiological factor.

**Gross appearance.** In appearance and size the benign mucocoeles varied from the practically normal size appendix with hardly noticeable cystic formation containing mucoid material to the large thin walled cyst involving the whole appendix and reaching the size of a full grown cucumber. On gross examination of the lining of these cysts one is struck with the quite uniform smooth wall and the absence of any papillary formation.

**Histological appearance.** These simple mucocoeles show histological structure in the wall varying from an almost normal mucous membrane with some predominance of mucous cells (Fig. 1) to a thin hyaline membrane practically devoid of lining epithelial cells (Fig. 2). Between these two extremes were found specimens with walls packed with mucous cells lined by a single layer of mucous cells (Fig. 3). These various histological pictures seem to represent different stages of same process.

**Pathogenesis.** After careful study of the gross and microscopic anatomy of these simple

mucocoeles it seems the pathogenesis of this lesion is as follows. First an obstruction of the organ is formed with the lumen open distal to it. This obstruction is practically always due to a stricture which is the result of one or more attacks of inflammation in the appendix. The normal mucous cells of the mucous membrane continue to secrete into this closed lumen. As the process continues there is an apparent increase of mucus-secreting cells in the lining membrane with a dying out of the other cellular structure and the walls of the organ are consequently gradually distended by the accumulating gelatinous material. The process continues, and finally the walls become so stretched out that their nutrition is seriously interfered with. Then even the mucous cells begin to disappear. If the process continues long enough the walls become hyalinized and all that is left is an inert cyst containing relatively innocuous gelatinous material. As would be surmised at times these lesions attain quite large size. At any stage in this cycle the cyst may rupture and pour some of its contents into the abdominal cavity. The opening may heal almost immediately and the process continue or the hole may remain open for some time and gelatinous material continue to leak out into the peritoneal cavity. Thus mucinous material in the peritoneal cavity a study of these cases shows, is undoubtedly handled by the body without ill effect.

**Clinical significance.** Interesting evidence in favor of the benignity of these lesions is the fact that in 8 instances the contents of the



Fig 7



Fig 8



Fig 9

Fig 7 High power view of adenocarcinoma, grade 1, in appendiceal cyst wall. The detailed structure can be quite well made out. Note the nuclei which are larger than in the normal cell and which tend to extend up the length of the cell rather than to limit themselves to the region of the basement membrane as in the benign epithelium lining the gastro intestinal tract (hematoxylin and eosin,  $\times 75$ ).

Fig 8 Wall of appendiceal cyst showing transitional stage between simple mucocele and adenocarcinoma, grade

1. The papillary arrangement is present but the nuclei are still well confined to the region of the basement membrane (hematoxylin and eosin,  $\times 25$ ).

Fig 9 High power photomicrographic view of the transitional stage. Note the papillary arrangement of the mucous membrane with the nuclei limited to the base of the cells. A few regions may be noted where the nuclei are just beginning the process of lengthening out (hematoxylin and eosin,  $\times 75$ ).

mucocele had leaked into the peritoneal cavity at the time of exposure or had ruptured at the time of removal with consequent spilling of the contents into the abdominal cavity, and that in 1 of the 8 cases there were quite large amounts of gelatinous material free in the peritoneal cavity. These, however, did not seem to be adherent to the peritoneum which is the usual situation with the malignant lesion. In spite of this leakage into the peritoneal cavity, none of these histologically simple mucoceles that could be followed went on subsequently to produce the clinical picture of pseudomyxoma peritonei.

It becomes apparent that there is little clinical significance attached to the simple mucocele other than to differentiate it from the cystadenoma which contains true adenocarcinoma, grade 1. The lesion gives very little evidence to warrant a clinical diagnosis. A few of the larger cysts were palpated through the intact abdominal wall, and an occasional patient complained of an indefinite ache in the right lower quadrant, but generally speaking one finds very little to warrant a clinical diagnosis of this condition.

**Group 2 Etiology** In discussing the cystadenocarcinomas, grade 1, of the appendix we shall first consider the causation of the condition. Naeslund has published a paper on the

experimental production of pseudomyxoma peritonei in rabbits. He ligated the appendix in newly born rabbits about 15 centimeters from the tip and cut across it just distal to the ligature. The distal stump was left open and the blood supply through the meso-appendix was not disturbed. In most of the animals little mucous cysts developed between the cut stumps of the appendix. Some of them burst and mucous material spread over the peritoneum. In some animals small cysts about 1 cm in diameter filled with mucus developed in the mesentery, intestines, and peritoneum. The little cystic nodules were covered with epithelium. At times cylindrical mucosal epithelium would grow into the serosa and wall of the bowel, forming nests of this epithelium in glandular or nonglandular arrangement. Within these nests were collections of mucus.

**Gross appearance** All of these cysts that showed adenocarcinoma, grade 1, presented a uniform and quite definite gross picture. In the cysts are found regions of fine papilla-like meshwork. This is in direct contrast to the benign mucoceles which as we have mentioned, uniformly show a smooth lining. The malignant lesions varied from a small one in the tip of the appendix which barely distorted the form of the organ to one which measured 4 by

9 centimeters. In this series they were not as large as some of the benign mucoceles.

**Histological appearance.** Figures 4, 5, 6 and 7 are photomicrographs of some of this group of malignant lesions and show the picture which is found in all of this group—namely a papillary arrangement of the mucous membrane, a comparative hypertrophy of cells and nuclei and nuclei which are hyperchromatic and tend to extend up the length of the cell rather than to limit themselves to the lower part of it as in the benign epithelial cells lining the gastro-intestinal tract. Four of the appendices of this group were associated with intracystic adenocarcinoma of the ovary, but because of reasons which we shall discuss later we were not able to prove that the condition was not primary in the appendix and, therefore, they were included in this group.

**Pathogenesis.** In the walls of some of the benign mucoceles it was possible to find regions which seemed to be approaching the picture of adenocarcinoma, and we interpreted them as being transitional stages between the benign and malignant states. Figure 8 is a low power photomicrograph and figure 9 is a high power photomicrograph of one of these regions in a mucocele from one of our cases. These pictures show the definite papillary arrangement characteristic of adenocarcinoma and in some regions the nuclei tend to lengthen out a little and approach the malignant form. However, careful study of these sections will place them definitely in the benign class. On the basis of Nacaland's experimental work and the results of our pathological study we wish to propose the hypothesis that the grade 1 adenocarcinoma in appendiceal cysts is the result of malignant change which takes place somewhere in the pathogenic cycle of the simple mucocele and that this in turn is the result of an obstructive process in the lumen of the appendix.

**Clinical significance.** Four of the 10 cases of cystocarcinoma of the appendix were associated with a similar condition in the ovary and it is quite true that the condition in the appendix might have been secondary or metastatic to the condition in the ovary. However, in these 4 cases from an anatomical standpoint the condition was also primary in

the appendix and we therefore feel that they should be included in this group. In each of these 4 cases both grossly and microscopically the carcinomatous material lined the inner cyst wall and as far as we could ascertain, was an intrinsic part of it. It is interesting to note that 6 of these 10 specimens were unruptured at the time of operation and possibly would have gone on through the patient's life without rupturing or giving any trouble.

It appears that true pseudomyxoma peritonei of appendiceal origin is a very rare condition. In this series there were 10 intracystic carcinomas in about 43,000 surgically removed appendices, an incidence of 1 in 4,300.

#### SUMMARY AND CONCLUSIONS

In this paper we have presented the results of a clinical and pathologic study of cystic tumors of the appendix or as they are more commonly called mucoceles, found in the group of approximately 43,000 appendices which were removed surgically at the Mayo Clinic between January 1, 1914 and June 30, 1938 inclusive.

The cystic tumors studied in this paper were divided histologically into a benign group of 136 cases, and 10 cases in which grade 1 adenocarcinoma could be demonstrated within the cyst.

The benign group was studied individually. It was concluded that mucoceles of the appendix are the result of stricture of the lumen which usually is caused by inflammation. Evidence was introduced to establish the benign nature of this group.

In discussing the group of cystocarcinomas the hypothesis was presented that they are the result of malignant change in the wall of the benign mucocele. It was concluded that true pseudomyxoma peritonei of appendiceal origin is a very rare entity.

In concluding we may say that simple mucoceles seem to have little clinical importance. It is true that at times a benign cyst of the appendix does seem to be the cause of vague symptoms, but on the whole they seem to have little significance. It appears also that cystocarcinomas of the appendix rarely reach clinical stages, but potentially they may rupture and be the cause of pseudomyxoma peritonei.

tonci with a lethal outcome. The opinion held by many authors that pseudomyxoma peritonci of appendiceal origin is less malignant than the same condition originating in the ovary in our opinion is erroneous and is due to the fact that many of the cases reported as pseudomyxoma peritonci of appendiceal origin were not the true malignant condition, but rather were due to the escaping of the innocuous contents of benign cysts into the abdominal cavity. On the other hand, the cases that do go on to a fatal outcome probably all originated in a carcinomatous cystadenoma of the appendix.

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# ADENOSIS OF VAGINA AND ITS RELATION TO PRIMARY ADENOCARCINOMA OF VAGINA

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**I**n 1927 the senior author then at the Woman's Hospital described diffuse permeation of the vaginal wall by glandular structures under the title "Diffuse Adenosis. In spite of its rarity this disease is of interest not only for the pathologist but it is also as we shall see in the course of this paper of practical importance.

Since 1927 two further cases were observed—in Beth Israel Hospital—and a search of the literature has brought old and new observations to our knowledge none from the Western Hemisphere. The older publications appear in a different light today after we have learned more about the embryology of the vagina.

**CASE 1.** Patient L. G. No. 56, 36 years old. Patient has had 16 children. Menstruation has always been regular and menopause occurred long ago. Patient had been bearing primary for years. She came to the hospital at that time because the primary infection had become so severe that she wanted to be operated upon. A 3 1/2 inch vaginal hysterectomy was done and during the operation much scar tissue was found in the anterior vaginal wall, probably dating from some previous operation. The uterus was atrophic. It contained small myoma. The endometrium was thin. A torn small piece of vaginal wall was sent separately to the laboratory. One half of it was 5 centimeter thick, the other half centimeter. In the thicker half immediately under the surface a brownish cyst, millimeters in diameter, was situated. Microscopically in this region four cystic spaces were found under the epithelium measuring 0.5 and 0.5 millimeter respectively. They were round or ellipsoid with the long axis at right angle to the surface. One was branching. The cysts were lined with high cylindrical epithelium, the nuclei being situated near the base. The protoplasm was clear and gave positive mucarmaline reaction. It placed the epithelium as flattened. The lumen contained mucinous material together with cellular debris. The surface epithelium over these small cysts as normal, not thinned out. The cysts were separated from the surface epithelium by thin layer of connective tissue. Throughout the length of the sections (5 centimeters) in the sub-

epithelial connective tissue, glandular ducts were scattered. They had not caused visible thickening. They reached up to the edge of the section. These glands were rather narrow they were running vertically or obliquely in relation to the surface, and they were somewhat branching. They were lined with the same kind of high epithelium and in general were similar to cervical glands. At several points the normal appearing basal layer of the surface epithelium as found continuous with the epithelium of the glands. Some of the glands opened into the lumen of the vagina, through a gap in the surface epithelium. There were no real duct lined with epithelium but the mucus-producing glands had broken through the overlying epithelium. The narrow ducts contained mucinous material and cellular debris. The subepithelial connective tissue was slightly infiltrated with round cells.

Five years later the patient, according to her family physician was in good health and had no gynecological symptoms.

**CASE 2.** Patient G. S. No. 49284, 33 years old. Patient had had 5 pregnancies, 1 miscarriage. Periods had been regular. 5 day cycle last menstruation occurred 3 weeks before admission. This patient came to see the physician because for some time she had vaginal bleeding after intercourse. There were no other complaints, especially no gynecological ones. On vaginal examination, a somewhat indurated ulcerated area with irregular surface as found in the right fornix. The preliminary diagnosis was doubtful carcinoma of cervix and vaginal wall. The indurated area in the vagina was excised with cauterization of the edges. A small piece of cervix also was removed for diagnostic purposes.

The cervical tissue on microscopic examination showed only slight inflammation. There was nothing to suggest the presence of tumor.

The piece from the vaginal wall measured by 5 by 5 centimeter. Its one surface looked similar to muscle tissue the other one had few irregular rounded protrusions. One edge the tissue seemed somewhat firm. The material divided into three portions and cut serially.

The surface epithelium, as far as it preserved, was thick throughout the area. On vaginal examination, had appeared ulcerated. It was missing and not one of glands formed the surface instead. These glands continued beyond the ulcerated area under intact surface epithelium they did not, however reach the edge of the section. As in the first case the glands were situated only in the subepithelial connective tissue and did not penetrate

<sup>1</sup> Clinical data furnished by Dr. Ralph Cobb.

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into the muscular layer. The glands formed a labyrinth, some of them were narrow, some dilated. The widest ones reached 2.5 millimeters. The epithelium lining the ducts and cavities varied. In places it was characteristic mucinous epithelium as in the first case, in others it was cylindrical, with the nuclei in the middle of the cell, eosinophil cytoplasm and indistinct cell borders. In other places, notably in the larger cysts, the epithelium was cuboidal or flattened. The mucicarmine reaction was strongly positive in the protoplasm of most of the glandular epithelium, and certainly also in the mucinous amorphous material which filled many of the lumina. A similarity to cervical glands was noted in places only. Many of the epithelial cells did not have the morphological aspect of mucinous cells but of ordinary secreting cylindrical elements, the mucicarmine reaction, however, was positive. In this case also the glandular epithelium in places was continuous with the basal layer of the surface epithelium, and some glands had broken through the surface epithelium as described. In a few areas the surface epithelium grew down into the glands in solid pegs, filling the lumen of the underlying gland. In places the squamous epithelium lifted up the cylindrical epithelium by growing under it, as described in the healing of erosion by Robert Meyer. The connective tissue surrounding the glandular structures was inflamed, lymphocytes and plasma cells prevailing, polymorphonuclear leucocytes were few.

No follow-up notes are available.<sup>1</sup>

**CASE 3.** A nulliparous 52 year old woman was admitted to the Woman's Hospital in 1916 on account of a profuse persistent vaginal discharge. At the age of 36 she had been curetted in another hospital, and it seems that at that time the vagina was found normal. Menopause began at 49. Vaginal examination revealed a large tumor protruding from the posterior vaginal wall, and biopsy was performed. The pathological diagnosis at that time was diffuse malignant adenoma of the vagina, originating from the Bartholinian gland. Vagina and cervix were amputated. The resected cervix was 4 centimeters long, the external os was nulliparous, the vagina was 12 centimeters long, 5 centimeters wide. The whole inner surface was deep red and there were a number of irregularly outlined ulcers with depressed center. Many small verrucous protrusions could be seen. The submucosa and the outer layers of the vaginal wall appeared intact. In the form of the vaginal wall seemed to have an intact surface also.

On microscopic examination the whole surface epithelium appeared destroyed by necrosis and inflammation. The subepithelial tissue, which was diffusely permeated by glandular structures, formed the surface. The connective tissue was inflamed, partly hyalinized, it was thickened. Lymphocytes and plasma cells prevailed in the inflamed area, but

there were also a few polymorphonuclear leucocytes. These cells formed thick coats around the glands, creating a superficial similarity with cytogenic tissue. The glands were found in almost every section from the different portions of the vagina. They were heaped up in some, scattered in others. On account of the necrosis of the surface layers, no statement could be made concerning connection between glands and surface epithelium. There was no connection whatever between the glands in the vaginal wall and the glands of the cervix. Special attention was given to this point, the cervix was examined at several levels, no pathological lesions were found.

The whole arrangement of the glands, however, was so similar to that in the 2 other cases that we may assume a similar relation to the surface epithelium having existed. The more superficially situated portions of the glands were running at right angle to the surface, branching and forming coils in the deeper layers. Most glands were narrow, few were moderately distended. There was little tendency to the formation of cysts. The whole glandular picture was much less regular than in the two other cases, but the basement membrane could be recognized wherever the inflammation was not too severe and the epithelium formed only one layer throughout. The variation in the character of the epithelial cells was the same as described in the other cases. The glands also did not invade the muscular tissue. The outer layers and the paracolpium were intact. The cervix, as mentioned, was examined very carefully and, except for slight inflammation, nothing unusual was found. Endometrium and myometrium showed senile changes.

Thus in 3 women who were in the menopause or near it, mucinous glands were found in the wall of the vagina. In Case 1, there were no clinical symptoms, the glands were found accidentally and were covered entirely with normal vaginal surface epithelium through which some of the glands emptied by means of narrow gaps. Some of the glands were distended to small cysts. In Cases 2 and 3, the patients mainly complained of a severe leucorrhea, in Case 2 bleeding after intercourse also was noted. In these 2 cases the surface epithelium was destroyed—in a circumscribed area in one case, diffusely in the other—and the mucinous glands thus formed the surface of the vagina. Correspondingly, in 1 case, a circumscribed lesion had presented itself which was clinically considered carcinoma, the lesion in the other case also was considered malignant and treated as such. In 2 cases no recurrence and no metastases took place, one could not be followed up.

<sup>1</sup>Clinical data furnished by Dr. M. C. Lilienfeld.

<sup>2</sup>This case formed the subject of a presentation by Dr. Plaut before the American Association of Pathologists in 1927.



Fig. 1. Case . . . Under the normal vaginal epithelium, glands retracted they vary in size and shape.

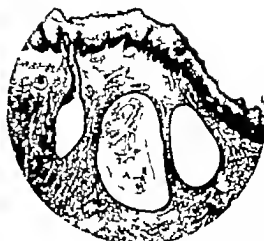


Fig. 2. Case . . . Three dilated glands. The lining of one gland is continuous with the surface epithelium.

It seems reasonable to consider these 3 cases as 3 different phases of one and the same lesion which is mainly characterized by the presence of mucinous glands in the wall of the vagina. On account of the even distribution of the glands, and of the arrangement of epithelium in single layers, which facts both speak against tumor-like overgrowth, we see fit to retain the name adenosis which was used in the presentation of our case in 1927. The name adenomatosis used by others would make the disease a true tumor which, in our opinion it is not.

#### ANATOMICAL AND EMBRYOLOGICAL CONSIDERATIONS

The presence or absence of glands in the normal human vagina has been much discussed notably in the last decade of the last century and the first one of ours. Most of the anatomists are of the opinion that the normal human vagina does not contain glands. Hyrtl states that glands occasionally are seen, and, according to Maximow, the fornix sometimes contains glands of cervical type. The much quoted statement by von Preuschen that he had found glands 6 times while examining the vagina in 30 autopsies has been doubted from the beginning and cannot be accepted. Robert

Meyer (9) has seen gland-like formations in older fetuses, and Schroeder states that they can be found in one third of all older fetuses. These formations however as Robert Meyer himself has stressed are entirely different from mucinous glands. Mucinous glands in the vagina must be extremely rare. Robert Meyer has seen them once in a fetus and does not make any statement of having ever seen them in the adult. An extensive search of the literature confirms our opinion that these glands are extremely rare and we have a right to make the definite statement that mucinous glands do not form part of the normal human vagina. This statement is not modified by the study of the cyclic changes in the human vagina. No mucinous change of the epithelium has ever been found in the human vagina.

The question arises under what circumstances are the mucinous glands of adenosis formed in the vagina? They are covered by the normal vaginal epithelium only some of them open into the vaginal lumen but formation of cysts is not very marked in spite of the fact that the epithelium is found secreting. Thus it is not probable that we are dealing with congenital abnormalities. The gland must develop in later life. Their great rarity

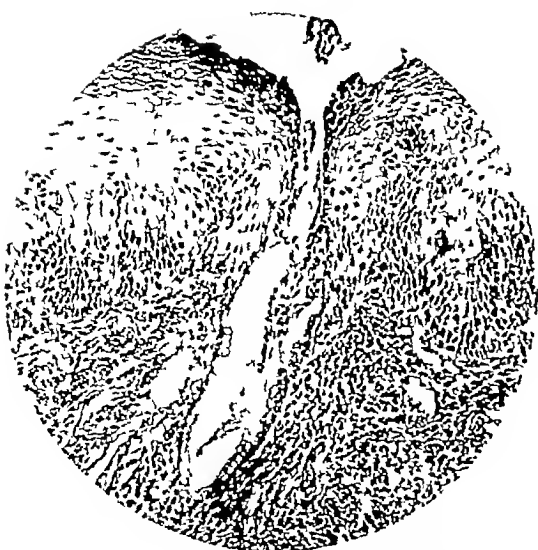


Fig 3 Case 1 One mucinous gland has broken through the surface epithelium. The subepithelial tissue is inflamed.



Fig 4 Case 3 The gland is lined with a single layer of mucinous epithelium. Surrounding connective tissue is inflamed. This tissue does not resemble cytogenic tissue.

makes it improbable that every vagina under certain circumstances has the power of forming cervical glands, as Robert Meyer has assumed. We believe that certain parts of the vaginal epithelium may have retained the capacity of forming mucinous glands. This hypothesis is supported by the modern concept concerning the embryology of the vagina (Robert Meyer, 10, 11, and Vilas). According to these authors, the human vagina is not lined with muellerian epithelium but with epithelium of the urogenital sinus. This epithelium grows upward and forms the permanent lining of the vagina. During this process, first the lateral parts of the vagina are occupied, while a narrow zone in midline, notably in the upper half, is occupied for a longer time by muellerian epithelium. It might happen that in certain parts of the vagina muellerian epithelium remains, these cells then might, even in the adult woman, be able to differentiate into mucinous epithelium as the muellerian epithelium normally does in the cervix uteri. This process would not represent a metaplasia, if by metaplasia we understand the transformation of a fully differentiated tissue or cell type into another fully differentiated one. Our hypothesis does away with the precarious assumption of embryonic

remnants. Slight flaws in the embryological development, which as we know are frequent, would be sufficient to explain the possibility of the formation of mucinous glands in the adult vagina. Schiller has expressed himself in similar fashion—in spite of the fact that he uses the term metaplasia. This hypothesis also explains the similarity of the glands with cervical glands since cervical glands are of muellerian origin.

#### CASES FROM LITERATURE<sup>1</sup>

Adenosis of vagina is very rare. To our knowledge, no other case has been reported in the American literature. It was difficult to find the pertinent case reports because a variety of diagnoses have been made on these cases. We are quoting the cases not in chronological order but corresponding to the intensity of the change in the vaginal wall. We begin with glandular structures found accidentally in the vaginal wall, without pertinent clinical symptoms having been present.

Davidsohn, 1900, found cockscomb like protrusions extending from the middle of the vagina up to the fornix for a distance of 3 to 4 centimeters later-

<sup>1</sup>More cases of adenosis may be hidden in the literature under various headings. See for instance, Figures 3 to 6 in Table V in the paper by Anton Sitzenfrey, "Das Uebergreifender Adenomyome des Uterus auf den Mastdarm," *Zschr. f. Geburtsh. & Gynaek.* 1909, 64, 538.

ly on the right side. The patient was 37 years old, and sterile. Glandular structures, resembling cervical glands, were situated in the subepithelial connective tissue. The muscular layer did not contain glands. The glands were lined with clear cylindrical epithelium; they were branching; they resembled cervical glands. Some of them were cystic, some opened through the normal vaginal epithelium. A cellular stroma surrounded them. The author considered the glands as scattered congenital erosion.

In our opinion, the lesion represents adenosis of vagina similar to our Case 1. The glands in Davidsohn's case were entirely covered by the epithelium and did not give rise to clinical symptoms. In our opinion, one should talk about a congenital erosion only when glands looking like cervical glands are found in the immediate neighborhood of the vaginal portio. Assuming that the lesion in Davidsohn's case had been an erosion, it could only have been a healed erosion and there were no indications that cervical epithelium previously had been on the surface which was found covered with normal vaginal epithelium when the tissue was examined. Furthermore, the cervix itself was found normal. Nuernberger considers Davidsohn's case as adenomyosis of vagina. We cannot share this opinion. The cellular tissue around the cervical glands is not sufficient evidence. The cervical character of the glands also speaks against adenomyosis and so does the lack of glands in the outer layers of vagina and the absence of clinical symptoms.

Zacherl, 933 found cockcomb-like polypoid swellings in the middle and upper third of the vagina. The patient, a 5 years old, pregnant, and came to the clinic on account of cystitic symptoms. Biopsy revealed tortuous, slightly branching glands with high cylindrical epithelium. They were scattered under the slightly thinned out vaginal epithelium; the glands opened into the vagina. The stroma surrounding them in places appeared decidual. Zacherl considered the glands as ectopic cervical glands. The cervix was normal.

In this case the similarity with cervical glands is very marked in the other cases the tortuosity, the branching and the conglomerate nature are much more marked.

Poonpudsa (880) patient, a 35 year old, primipara, secundigravida, who 5 years before admission had noticed swelling in the posterior wall of the

vagina, between the middle and the upper third. Lately the mass had been growing, in the opinion of the patient, and on examination it had the diameter of 1 francs piece. The cervix was intact. The mass revealed it consisted of about fifteen small cysts which were scattered under normal vaginal epithelium. They were lined with high cylindrical mucinous epithelium. The cysts contained mucous matter.

In the case of Geyl, 894, no clinical data are available. A torus in the right vaginal wall, a some hat larger cyst as situated. The cervix was normal. Between the cyst and the normal vaginal epithelium, adenoma-like glandular ducts were found. They were lined with clear cylindrical epithelium. There was no connection with the surface epithelium.

Geyl is of the opinion that the cyst originated from one of the glandular ducts. He thus has shown the possibility of so called isolated vaginal cysts arising from adenosis. It is quite possible that careful examination of the vaginal tissue next to seemingly single cysts might bring to light more such instances.

While removing fibromatous polyp from the vagina of 30 year old, quadripara, Wulmer<sup>904</sup> found several small subepithelial cysts in the posterior vaginal wall. The largest measured 6 millimeters, none reached deeper than 8 millimeters into the wall. Some of the structures were round some cockcomb-like. A single layer of cylindrical epithelium with basal cells formed their lining. The epithelium was considered mucinous epithelium by Wulmer. Some of the glands opened into the lumen by means of narrow ducts. The glands did not show the histological connection between the basal layer of the surface epithelium and the glandular epithelium as found. The cervix was intact. In this case also the glands were found accidentally.

In the cases mentioned so far no doubt had existed in the minds of the clinicians that the lesion was entirely benign. Correspondingly no follow up reports are available.

Whitehouse, 1190 found multiple small cysts in the anterior and posterior wall of the upper part of the vagina. The patient, a 4 years old, secundipara, complained of persistent mucopurulent discharge. She had an extensive erosion of the cervix. The vaginal cysts were situated under normal epithelium, their epithelium was partly cylindrical partly cuboidal. Whitehouse believed that the erosion had extended over the vagina.

We assume that in this case also adenosis similar to our Case 1 has been present. Since the glands were all covered with normal



consider this lesion as a very severe adenositis of vagina with characteristic clinical and histological picture

In 930 Sca well reported a case which seems to be adenositis of vagina as far as the picture given permits us to judge. The case was published under the diagnosis primary adenocarcinoma of vagina. The patient was 38-year-old nullipara. For 8 years she had had vaginal discharge which resisted all treatment. She had a feeling of heat in the vagina and in the last 3 years there had been occasional spotting. Uterus and cervix on examination appeared normal. In the vagina there were "multiple flat, hyperemic lesions varying in size from 1 to 0.5 millimeter. These were distributed throughout the entire vagina but were more numerous in the lower third. On the photograph glandular structure is seen situated under normal vaginal epithelium. It is lined with single row of regular high cylindrical epithelium. The surrounding subepithelial connective tissue is inflamed. There seems to be a close connection between the surface epithelium and the glandular structures.

As mentioned, we feel that this case is diffuse adenositis of the vagina. Thus the conservative treatment appears doubly justified and the prognosis better.

#### POINTS OF INTEREST IN CASES FROM LITERATURE AND IN OUR OWN CASES

The histological descriptions quoted from the literature are very similar to our own cases. It seems unnecessary to describe the histological picture again in detail and there is no doubt that we deal with a characteristic entity. A few points might be stressed again. Most authors have talked about aberrant cervical glands or about very extensive erosion of the cervix. But the shape of the glands and of the epithelium is identical with that of cervical glands only in a few of the reported cases, in others there is a certain similarity. Obviously the differentiation of the glands in the wall of the vagina has reached different degrees in different cases. The assumption that these epithelial cells represent different phases of differentiation of originally indifferent muellerian vaginal cells seems to us well founded. A lesion should be called "erosion" only when it is situated on the cervix. A further difference between adenositis of vagina and the so called cervical erosion lies in the fact that in adenositis squamous epithelium is not replaced by cylindrical epithelium as is characteristic for the erosion. In the early

phases of adenositis of vagina the vaginal glands are completely covered by the normal squamous surface epithelium of the vagina. The glands form the surface of the vagina only when the squamous vaginal epithelium is destroyed. The picture seen most frequently bears a certain similarity to the healed erosion and occasionally squamous epithelium is growing into the vaginal glands as it does during the process of healing in the cervical erosion.

The most striking clinical symptom is the severe and persistent vaginal discharge in the presence of a non-diseased cervix. The discharge sometimes is thin serous sometimes tenacious. Bleeding on touch and a feeling of heat in the vagina are further important symptoms. On examination one either finds a circumscribed swelling and induration which might simulate ulcer or carcinoma, or the vaginal wall is diffusely red and swollen. In the latter case there often are small protrusions in rows, they may be polyp-like or cystic. The upper third of the vagina and the midline are mostly affected but adenositis may also be found in the lateral vaginal wall and down near the introitus. The polyps and the small cysts frequently are found accidentally.

Since adenositis never has been found in children and since mucinous glands have been found only once in the vagina of an embryo we must assume that the gland like differentiation of the indifferent vaginal epithelium takes place in young adult women. This might induce one to look for relation to the anatomical and physiological changes connected with menstrual cycle pregnancy and childbirth. The available data, however give no hint in this direction. We do not know either why in some cases the surface epithelium of the vagina becomes destroyed sometimes in isolated spots sometimes over large areas. One might assume that material secreted by the vaginal glands does macerate the surface epithelium. While it is possible that in extensive adenositis a large number of glands opening through intact epithelium might cause considerable discharge we have no definite information about this because the sections from single biopsies do not give a complete picture of the condition

They were removed easily. Local excision, perhaps followed by radiation, seems to lead to a permanent cure. We do not know of any death from adenocarcinoma of the vagina. It little matters whether one calls these tumors adenoma or adenocarcinoma with low malignancy.

#### SUMMARY AND CONCLUSION

1 The term adenositis of the vagina designates the presence of glands in the subepithelial layers of the vaginal wall, which normally does not contain glands.

2 Adenositis of the vagina does not occur in children. The youngest patient was 25, the second youngest 27, 4 belonged to the fourth decade, 3 to the fifth, the 3 oldest ones were 50, 52, and 62 years old, respectively. In 1 case no age was given.

Three of the patients were nulliparous — 1 was young, 1 middle aged, and 1 old. In 1 case parity was not mentioned.

3 As long as the overlying vaginal surface epithelium remains intact, adenositis of the vagina need not make symptoms. When the vaginal surface epithelium is destroyed, a characteristic gynecological picture arises, mainly consisting of a copious vaginal discharge, a feeling of heat in the vagina, and bleeding on touch.

4 Adenositis of the vagina may be diffuse or circumscribed. Circumscribed adenositis of the vagina may simulate carcinoma of the vagina. Seemingly single vaginal cysts may be part of an adenositis of the vagina.

5 Primary adenocarcinoma of the vagina probably in most instances originates from adenositis. These rare tumors, which give the histological picture of adenocarcinoma, are relatively benign.

6 The glands in adenositis of the vagina morphologically resemble cervical glands, but they do not originate from the cervix. The cervix may be entirely normal in adenositis of the vagina.

7 The glands in adenositis of the vagina probably originate from muellerian epithelium which takes part in the formation of the vaginal epithelium.

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the epithelium was irregular some cells contained mucus and the diagnosis of an adenoma of inverting type was made. The basal membranes were intact throughout.

In the opinion of the author with which we agree the tumor originated from the vaginal glands. Corresponding to the aforementioned numerous nodules in the vagina, glands were found under intact vaginal epithelium they were lined with a single layer of high cylindrical epithelium and resembled cervical glands. Occasionally an opening into the lumen of the vagina was found. In Penkert's opinion with which we agree the glands probably originated from the basal layer of the surface epithelium.

Hoehne's patient was 35 years old.

The posterior vaginal wall in the upper third, directly to the right of the midline contained deep red cauliflower tumor whose upper edge was 1 centimeter from the posterior cervical lip. The cervix appeared normal. The last delivery of this quadruparous woman had taken place only 3 months before admission. She complained of partly bloody discharge loss of weight anorexia, and constipation. Bladder and rectum were normal. Biopsy showed adenocarcinoma and radical operation was performed. Uterus and cervix were normal. The tumor was mainly situated in the subepithelial connective tissue of the vagina. At a few points only it encroached little upon the musculature but without reaching the outer layers. In a few areas muscle tissue was destroyed. The glands varied in size and shape. In places they are covered by the normal squamous epithelium of the vagina. The epithelium in the glands of the tumor in places was multilayered. In the vaginal wall between the cervix and the upper edge of the tumor glands were situated looking similar to cervical glands. The mucocutaneous reaction in their epithelial cells was positive.

It is logical to assume, as Hoehne did, that the adenocarcinoma originated in the vaginal glands.

Hoehne's paper does not mention mitotic figures, irregularities of nuclear structure or loss of basement membranes. We cannot decide whether this tumor should be called a true adenocarcinoma or an adenoma.

Strachan 1932 described 2 cases of primary adenocarcinoma of the vagina the patients being 50 and 48 years old, respectively.

In both instances the cervix was intact and the upper part of the vagina was occupied by soft, dark red, mushroom-like tumor mass which origi-

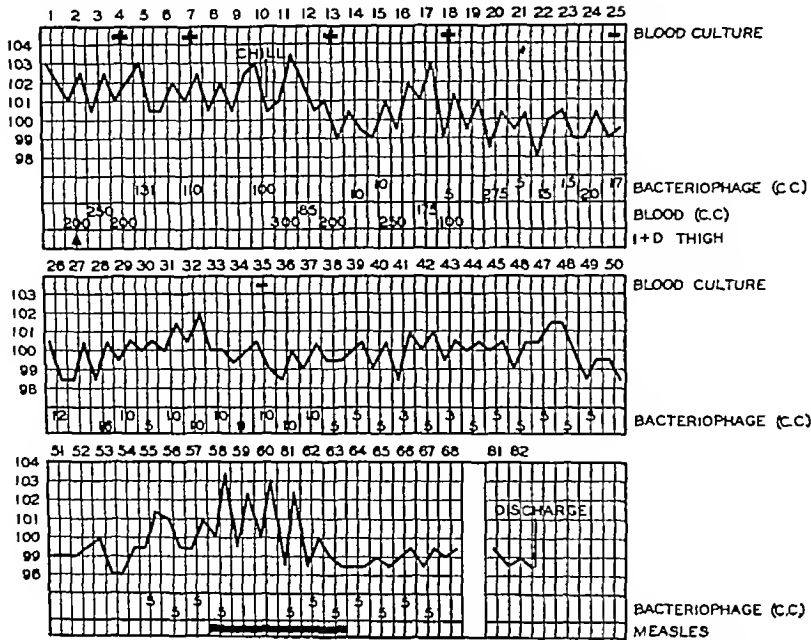
nated from the middle of the posterior wall. In both cases the tumor could be removed with the finger easily and with a negligible amount of hemorrhage. Both patients were treated with radium. In the first case after 1 year local recurrence took place which also was removed digitally. After removal of the tumor there was only a small superficial defect in the vaginal wall. The 2 patients were found in good health 30 months after the first treatment. In the second case only 3 months had elapsed at the time of publication. Both tumors were adenocarcinoma, partly with solid areas. It might be mentioned that the one patient was an octipara, the other one a nullipara.

Strachan discusses in detail the papers of Bonney and Glendenning and of Haultain. In his opinion these adenocarcinomas might originate from "ectopic cervical glands" he considers adenosis of the vagina a precancerous lesion. Our own Case 3 also demonstrates the formation of a large adenomatous tumor in a vagina affected with adenosis.

The tumors described by Moench Siefert, and Spencer might belong in the same category.

These reports indicate that an adenoma or adenocarcinoma can originate from adenosis. It is doubtful, however whether this gives us a right to call adenosis a precancerous lesion as Strachan does. The number of adenosis cases with tumor formation in the literature is almost as large as that of adenoid cases without. This might be interpreted in favor of the conception of a precancerous character. But adenosis probably runs its course in many cases without giving symptoms and thus is not recognized, while practically every case of carcinoma will be diagnosed and probably published if it is one of the rare adenocarcinomas.

In the gross specimen the adenoma and the adenocarcinoma may look alike. The tumors are cauliflower-like soft, dark red they develop into the lumen of the vagina without infiltrating the wall. They are easily removed often without the help of an instrument, and the hemorrhage is slight. Adenocarcinoma of the vagina, in spite of a somewhat rather irregular histological picture, is relatively benign. As far as our knowledge goes metastases have not been observed even when a large primary tumor was present for a long time. Local recurrences have been observed.



C Patients who had *one or more* positive blood cultures, did not appear severely ill and did not develop metastatic foci In this third group there are 3 patients, with no deaths

# THE USE OF ASPARAGIN BACTERIOPHAGE IN THE TREATMENT OF ACUTE HEMATOGENOUS OSTEOMYELITIS

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THERE has recently arisen in medical literature a discussion concerning the present concepts of treatment in acute hematogenous osteomyelitis. The formerly accepted dictum "Where pus is half suspected, let it out" (4) is being called into question and attention is being more and more directed toward the importance of adequate treatment of the systemic infection that exists in so many of these cases. It has been repeatedly pointed out that acute hematogenous osteomyelitis represents the osteoarthritic localization of a generalized pyogenic infection" (2, 3, 13, 16) and that the mortality is more dependent upon this septicemia than upon the local lesion in the bone (5). A recent statistical analysis by Brown (1) has also shown that the mortality is appreciably lessened when surgical intervention is delayed and restricted to a minimum as opposed to early radical operation. If then, as these reports seem to show, the systemic infection is the important factor in early hematogenous osteomyelitis, some specific antistaphylococcal agent applied early and vigorously might be of value.

Over the past 4 years we have had at the Pennsylvania Hospital and the University of Michigan Hospital the opportunity to treat with asparagin bacteriophage 12 consecutive cases of osteomyelitis associated with staphylococcal bacteremia. Over this period no patient was denied treatment provided he showed a positive blood culture for the Staphylococcus aureus in the presence of a local lesion in the bone and all patients fulfilling these criteria are included in this report. In addition to bacteriophage the usual surgical and supportive measures were employed, depending upon the individual indications.

The nature of the bacteriophage, its action *in vitro* and its clinical application have been

adequately discussed elsewhere by others (7 to 12) and its specific use in osteomyelitis has already been described (6). The present series of cases differs from the reports that have preceded it only in that all patients have received adequate bacteriophage therapy, whereas statistics previously reported have of necessity included all patients receiving bacteriophage whether or not the dosage had been adequate. It is our belief that the mortality rates reflect this difference.

The usual mortality rate of osteomyelitis with septicemia has been variously estimated at from 12 per cent (14) to 100 per cent. In order to determine this figure independently all of the cases of osteomyelitis with positive blood culture for the Staphylococcus aureus seen in the University Hospital since 1925 were reviewed. Of these there were 36 of whom 29 died—a mortality rate of 80.5 per cent. Of this number there were 10 who received no treatment other than adequate surgical drainage. Of these 8 died—a mortality rate of 80.0 per cent. There were 5 patients treated with antitoxin of whom 4 (80 per cent) died. Two received sulfanilamide and both succumbed. Twenty-six received blood transfusions and 20 or 76.9 per cent, died. Nine received minute doses of broth bacteriophage of whom 7 or 77.7 per cent died.

These figures, although including only a small number of cases, show a remarkably constant rate of survival which has not apparently been altered by any of the therapeutic agents used, including multiple transfusions, sulfanilamide, antitoxin, broth bacteriophage or unaided surgery. Therefore this series of 12 unselected cases, all having positive blood cultures with a mortality rate of 8 per cent would seem significant.

The bacteriophage used was obtained from the New York Post Graduate Hospital. It is made in a practically protein-free asparagin

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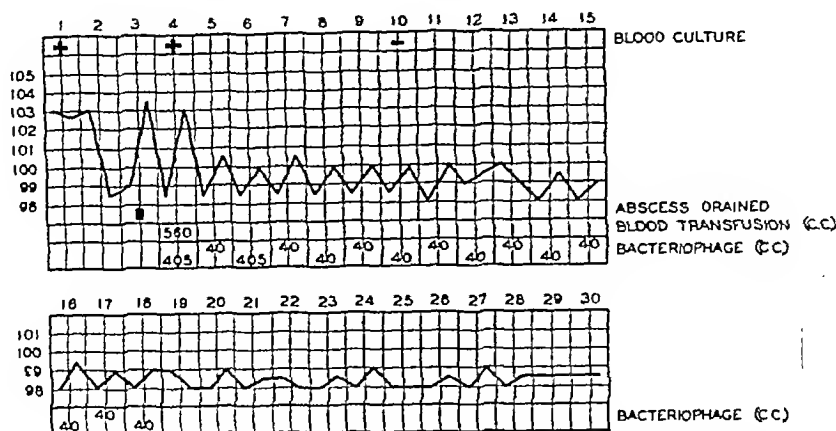


Fig 4. Case 4 R W, University Hospital No 304916 White female, aged 20

years ago which had been quiescent ever since. One week before admission he struck knee, and next day pain and swelling were noted, then fever, chills, and severe malaise. Blood cultures on fourth and eighth hospital days revealed *Staphylococcus aureus*. Clinical course and treatment outlined in Figure 3.

CASE 4 R W, 20-year-old white female, University Hospital No 304916, was admitted with the history of having suffered from chronic osteomyelitis of the right femur for 8 years. Six days before admission she had fallen, injuring the diseased area, and this was followed on the next day by severe pain in and about the right groin with limitation of motion of the right hip. There had been chills and fever, but the constitutional reaction had not been very severe. Blood culture on the first and fourth hospital days revealed *Staphylococcus aureus*. The clinical course and treatment are outlined in Figure 4.

#### SUMMARY

1. A series of 12 cases of osteomyelitis with positive blood cultures for *Staphylococcus aureus* is presented. These patients received, beside usual treatment of this disease, asparagin bacteriophage in adequate doses, intravenously.

2. Only one patient died. This rate, 8.3 per cent, is sufficiently lower than the previous experience in the University Hospital, 78 per cent, to suggest that the addition of asparagin bacteriophage to the customary treatment may have favorably influenced the course of the disease in these patients.

We are indebted to Drs. W. F. Lee and H. P. Brown, of the Pennsylvania Hospital, Philadelphia, and to Drs. I. A. Culler and C. F. Bradley, of University Hospital, Ann Arbor, for permission to treat these patients and report results.

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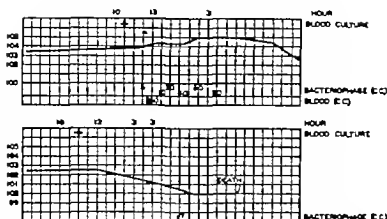


Fig. Case 2. P. K., University Hospital No. 448643. White female, aged 6.

The clinical courses of 2 patients from group A and one each from groups B and C are presented as examples of the method of treatment.

CASE 2. P. K., 7 year old, hit female University Hospital No. 432335 was admitted with the history of having struck the right leg 7 weeks previously. Pain and swelling had immediately supervened followed shortly by chills, fever, nausea, vomiting, and delirium. Cough had been present for week. Blood culture as positive on the fourth, seventh, thirteenth and eighteenth days. The clinical course as complicated by multiple lung abscesses which resolved under conservative treatment. An attack of measles occurred during the eighth week in the hospital. The clinical course and treatment are outlined in Figure.

CASE 3. P. K., 6 year old white female University Hospital No. 448643 as admitted with the

history that 4 weeks previously she had fallen, injuring the left knee. This had been followed once by local pain, swelling and limitation of motion with fever, chills and malaise. Repeated incision and drainage had been performed and sanerization carried out during this time. Blood culture had been persistently positive for *Staphylococcus aureus* during the past 3 weeks. A roentgenogram taken 7 weeks before admission had revealed multiple lung abscesses. Hemoglobin on admission at 3 per cent. Blood culture as positive (about 2000 colonies per cubic centimeter) on two occasions during the 7 hours that the patient survived. A autopsy revealed multiple pyogenic abscesses in all organs. The clinical course and treatment are outlined in Figure.

CASE 5. F. R., 20 year old, hit male University Hospital No. 43787 was admitted with the history of having had a acute osteomyelitis of the knee 6

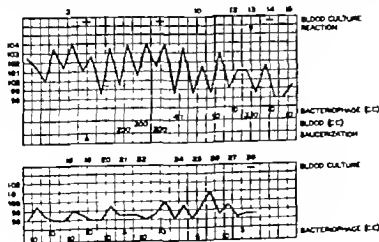


Fig. 3. Case 3. F. R., University Hospital No. 43787. White male, aged 20.

protected against toxin cannot, however, survive the subsequent injection of living staphylococci, although their period of survival may be significantly prolonged (2, 3, 14, 15). It may even happen that local infections develop in these animals, although an increased amount of antitoxin can be demonstrated in their blood serum (15).

It is characteristic of many staphylococcal infections that they tend to localize in the tissues or organs affected. Little opportunity for localization occurs when the infection is caused by a staphylococcus producing a potent toxin. If the subject is suitably protected, however, the action of the toxin is minimized, and the resultant effect is that due to the localization and establishment of infection by the staphylococcus. On the other hand, some strains of staphylococci produce no toxin, but that they are pathogenic is demonstrated by their ability to kill rabbits by dissemination of the organism through the tissues and consequent multiple abscess formation. This distinction between toxigenic and non-toxigenic staphylococci was reported by Burky, and has been confirmed by Julianelle and Wiegand, and by ourselves.

From our data, the results obtained in a study of 35 strains of *Staphylococcus aureus* isolated from the blood stream in cases of staphylococcal infections are described herein. Experimental studies were directed along three lines, first, determination of the ability of these strains to produce soluble exotoxin, second, ascertainment of the effect produced in animals by the injection of cultures which had been thoroughly washed to remove any trace of free toxin, and, third, analysis of the effect produced by the administration of staphylococcal antitoxin to rabbits infected with toxigenic staphylococci.

#### EXPERIMENTAL STUDY

For the study of soluble toxins, the staphylococci were grown in semisolid bacto-heart-infusion agar at 37 degrees Centigrade for 48 hours in an atmosphere containing 30 per cent carbon dioxide. The clear supernatants obtained after centrifugation were tested for  $\alpha$ -hemotoxin and for lethal toxin. The  $\alpha$ -hemotoxin titer is represented by the smallest

amount of toxin which completely hemolyzes 1 cubic centimeter of a 1 per cent suspension of washed rabbit erythrocytes after incubation for 1 hour at 37 degrees Centigrade.

**Lethal toxin.** For the determination of lethal toxin, the supernatants were injected intravenously into rabbits and mice. One rabbit weighing about 2,400 grams was used for each toxin, the dose being 1 cubic centimeter per kilogram of body weight. From 4 to 6 mice, weighing 18 to 20 grams each, were used for each toxin, the dose being 0.5 cubic centimeter. Rabbits and mice receiving highly potent toxins died, with characteristic symptoms, within from 1 to 15 minutes after the injection. Less potent toxins killed the animals in from 1 to about 6 days. Survival beyond this time indicated that little or no toxin was present in the supernatants.<sup>1</sup> There was a general, but not exact, correlation between the potency of lethal toxins and their  $\alpha$ -hemotoxin titers. Rapidly lethal toxins had  $\alpha$ -hemotoxin titers ranging from about 0.02 to 0.002 cubic centimeter. Less potent toxins had titers ranging from about 0.35 to 0.02 cubic centimeter.

**Effect of cultures free from toxins.** This toxin had been produced under favorable *in vitro* conditions. It was important to learn to what extent the staphylococci produced their pathogenic effects because of the *in vivo* production of toxin, or, lacking toxin, to what extent instead their pathogenic effects resulted from localization in, and impairment of function of, vital organs. For this purpose rabbits averaging 2,400 grams in weight were injected intravenously with saline suspensions of the cocci equivalent to the growth from one-half of a young agar slant culture. The cultures were washed three times in sterile normal saline to remove any free toxin. The last two washings contained no trace of toxin, as measured by titration for  $\alpha$ -hemotoxin.

The animals were kept under close observation until death, which occurred between 10½ hours and 12 days after injection. It

<sup>1</sup>An objection might be raised to the use of supernatants (which might contain a few cocci) rather than sterile filtrates. Suffice it to say that our previous experience has shown that the results here described are entirely comparable to results obtained with sterile filtrates. Animals dying within a week after the injection of supernatants have never shown any abscess formation which could be attributed to the presence of cocci. For the practical purposes of these experiments therefore the use of supernatants was considered to be adequate.

# CORRELATION BETWEEN CLINICAL AND EXPERIMENTAL FINDINGS IN CASES SHOWING INVASION OF THE BLOOD STREAM BY STAPHYLOCOCCI

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IT has been well established by numerous studies that some pathogenic staphylococci produce a soluble exotoxin which is comparable in many of its properties to the other recognized bacterial toxins (3, 5, 8, 21, 31). Space does not permit a detailed discussion of staphylococcal toxin but a few facts about it, pertinent to the present report may be mentioned. The effects of the toxin as observed experimentally include notably hemolysis of rabbit erythrocytes, intense necrosis of certain tissues and a rapidly lethal action in rabbits and mice. Some staphylococcal toxins may be sufficiently potent to kill rabbits within 2 to 15 minutes after intravenous injection. In the short interval between injection and death a characteristic series of events occurs. This includes unsteadiness, paralysis of the hind legs, rapid respiration inco-ordinate running movements, dilatation of the pupils, incontinence of urine and feces, and finally violent convulsions terminating in death.

Slightly less potent toxins, or small doses of potent toxins, cause death within a few days. Some of the symptoms described also appear just before death in these animals, particularly paralysis, rapid respiration, incontinence of urine and diarrhea. Accompanying these symptoms there has been observed in rabbits a marked increase of young myeloid cells in the bone marrow and proportionately in the circulating blood (9). When animals killed by toxin are subjected to postmortem examination (5, 7, 12, 19, 23, 24, 25, 26) hemorrhagic lesions are usually found in the lungs, myocardium and lining of the serous cavities. Necrosis is seen mainly in epithelial struc-

tures, such as the skin, the mucosa of the gastro-intestinal tract, and the tubular epithelium of the kidneys. Degeneration of the endothelium of the smaller blood vessels is also found especially in the glomeruli of the kidneys.

A clinical illustration of the effects of potent staphylococcal toxin is offered by an incident which occurred in Bundsberg, Australia, 12 years ago (13) and which stimulated considerable recent work on the staphylococci. Twenty-one children received a prophylactic injection of diphtheria toxin-antitoxin which had become contaminated by a highly toxic strain of staphylococcus. Within 36 hours 12 of these 21 children had died. The initial symptoms were cramps, vomiting and the passage of abnormal green slimy stools. Later the children became cyanotic. The temperature rose and there was an increase in the pulse rate out of proportion to the rise in temperature—in some instances to as much as 100 per minute. Near death, respiration became rapid, the children became comatose and restless, had repeated convulsions, and were irrational.

In consequence of clinical observations and experimental work on staphylococcal toxin an important rôle has been attributed to the toxin in the development of staphylococcal infections (1, 4, 6, 10, 22, 27, 29). It is possible that the toxin may be of primary importance in certain fulminating, rapidly fatal infections. A necrotizing toxin may also aid in the establishment of local areas of infection. However clinical observation (1, 4, 10, 22, 29) which corroborate experimental evidence indicate that toxin is often not the sole pathogenic factor. For example it is possible to protect animals against the effects of toxin by active or passive immunization. Animals so

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Read before the New York Pathological Society, February 29, 1940.

noted that cases of staphylococcal infection with invasion of the blood stream tend to occur in two year cycles, generally appearing between August and November. About 10 such cases have been seen in each of the years 1935, 1937, and 1939, with only occasional cases in the intervals between. No explanation for this occurrence is offered, but it appears to be worthy of mention.

Twenty-nine of these 35 cases have been sorted into two groups on the basis of certain consistent clinical characteristics which, as will be shown below, depend upon the susceptibility or resistance of the patients to the effects of staphylococcal toxin. Six remaining cases fall into a miscellaneous group in which factors other than toxin production may be involved. The features distinguishing these clinical divisions are as follows:

*Toxin-susceptible group* Fourteen patients exhibited clinical symptoms which must be attributed to the effects of the toxin. All were under 30 years of age, the majority being between 10 and 15. Eleven of the 14 patients died, the mortality rate being 78.5 per cent. The disease was usually ushered in by symptoms of a generalized infection, including those of an acute gastro-intestinal disturbance, such as anorexia, nausea, and vomiting, associated with indefinitely localized abdominal pain, tenderness, and spasticity. This was followed by diarrhea of an abnormal, watery, foul-smelling stool. The patient then became incontinent and remained so until death. Early irritability and restlessness were followed by coma and delirium, and before death the patients became completely irrational. Nuchal rigidity was present in most of the cases, but when lumbar puncture was performed the fluid and dynamics were found to be normal. Urinary symptoms, such as anuria, polyuria, and incontinence were often present.

On examination the patients were wet with perspiration and had cyanosis of the lips and of the finger-nail beds. The temperature was elevated. The pulse rate was also elevated to an extent out of proportion to the height of the temperature. None of the patients had chills. Embolic phenomena in the skin and conjunctivæ such as petechiæ, tiny pustules,

etc., were often present. Pupillary changes of the eyes varied, but were present in most of the subjects.

Analysis of the urine revealed changes characteristic of renal irritation, i. e., small amounts of albumin, occasional white blood cells, red blood cells, and clumps of pus cells. When cultures of the urine were made, these yielded staphylococci. While the total white blood count and the percentage of polymorphonuclear neutrophile cells were elevated, the variations in these counts in all 35 cases of this series were not consistent enough for them to be of any significance in differentiating between the groups. It was also noted that when the index of toxic granulations of the polymorphonuclear neutrophiles remained high or progressively increased, the patient died, although, on the other hand, the absence of a high index did not always signify that the patient would recover.

The severity of the symptoms appeared to depend upon the potency of the toxin produced by the infecting staphylococcus. When the effect of the toxin was greatest, the symptoms were most acute and the course of the disease was most rapid, lasting not over 9 days. The pulse rate was highest, ranging between 140 and 160 beats per minute, and the nonsegmented polymorphonuclear neutrophile cell count averaged 28.1 per cent. In these cases only an early stage of infection or none at all was present, and sufficient local infection could not be found to account for the severity of the symptoms. With less potent toxin the course of the disease lasted as long as 31 days until death, the pulse was usually below 140, although it rose above that level terminally, and the nonsegmented cell count was lower. Many of the clinical symptoms were referable to the action of the toxin. Superimposed upon this was clinical evidence of the development of metastatic infection, this combination being severe enough to cause death. When the effect of the toxin was least, the patients survived, the symptoms were mildest and gradually disappeared as the local focus of infection developed and was controlled. In 1 case of the group least affected by toxin, the infecting organism produced a potent toxin, but this patient was



was found that slightly more than one-third of the cultures studied produced sufficient toxin *in vivo* to kill the rabbits within 10 to 18 hours. The symptoms described as occurring in connection with the rapid death of rabbits from the effects of a highly potent toxin were seen in these animals, and in the same sequence. The difference was that the entire sequence required a period of hours instead of minutes, always ending in a short terminal period of dyspnea, convulsions, and incontinence of urine. Our close observation of this slower sequence of events leaves no doubt in our minds that death was directly due to the effects of the toxin elaborated *in vivo* by the staphylococci. There was no evidence of abscess formation during the relatively short period which elapsed before death. Cultures of the blood taken immediately post mortem yielded *Staphylococcus aureus*.

A few strains produced toxin somewhat more slowly killing the rabbits in 20 to 36 hours. A tendency toward localization was seen in the development of areas of infarction in the cortex of the kidneys of these animals.

Nearly one half of the animals survived from 2 to 12 days after inoculation. There were no signs of early toxin formation. There was a progressive loss of weight, and at autopsy there were cortical infarcts in the kidneys of rabbits dying within 2 days, and multiple abscesses of the kidneys and myocardium of the rabbits dying thereafter.

*Effect of administration of antitoxin.* The effect of the administration of antitoxin to rabbits injected intravenously with washed agar cultures of staphylococci was studied. Staphylococcal antitoxin (Lederle) was given intravenously at the time of the infecting dose and again at 24 hour intervals thereafter. When antitoxin was given to rabbits infected with a highly virulent strain of staphylococcus the animals survived from  $2\frac{1}{2}$  to 5 times as long as the unprotected controls. They eventually died, however showing multiple abscess formation. In contrast to the controls, which showed no formation of abscesses. When nontoxigenic strains of staphylococci were similarly injected into rabbits, those animals receiving antitoxin did not survive the controls for a significant

period. At autopsy of both the controls and the treated animals it was found that multiple areas of suppuration had developed.

It becomes apparent, therefore, that certain strains of staphylococci are highly toxigenic and may conceivably be responsible for certain fulminating, rapidly fatal infections in susceptible animals. The course is so rapid that there is little opportunity for the formation of abscesses. When the infecting organism is nontoxigenic, or when the effect of the toxin is removed by the administration of antitoxin, the course is prolonged and local areas of suppuration ultimately appear.

#### CLINICAL FINDINGS

In view of the differences between the toxigenic and nontoxigenic staphylococci it becomes important to learn whether clinical staphylococcal infections exhibit characteristics which indicate the type of organism causing the infection. Such characteristics might be of value both in differentiating between certain types of staphylococcal infection and in prognosis of the disease.

For this purpose we have reviewed 35 cases of staphylococcal infection with invasion of the blood stream which were treated in the Hospital for Joint Diseases between 1932 and December 1939. From a total of 43 such cases treated during that period, these were selected because in them the organism isolated from the blood was available for study so that it became possible to make a direct comparison between its effect on experimental animals and the clinical symptoms of the case from which it was isolated.

The total mortality rate for the 35 cases was 66 per cent. This rate is in harmony with the generally reported figures of about 66 to 83 per cent (16, 17, 18, 20) although recently lower mortality figures have been reported (16, 29). A tendency was noted, which has previously been reported by others (20, 28), for staphylococcal infections of bones and joints with invasion of the blood stream to be less often lethal than those of the soft tissues. We have found that staphylococcal infections with invasion of the blood stream are more likely to be fatal in patients under 30 years of age than in older individuals. We have also

markedly similar clinical pictures. They occurred in adults, 27, 33, and 38 years of age, and all were fatal. Admission to the hospital occurred after 3 weeks of mild, but steadily increasing, symptoms, and all 3 patients died within a few days after admission. The duration of symptoms was 23, 27, and 30 days, respectively. On admission the patients were in fair or moderately poor general condition, but shortly thereafter they went rapidly downhill and died. The temperature was high and fluctuating, going above 105 degrees Fahrenheit in all cases at death. The pulse rate stayed at about 120 to 130 beats per minute through most of the acute phase of the illness. Chills were present in 2 of the 3 subjects.

During the acute phase of the illness the symptoms, except for the slow onset (3 weeks) and the comparatively slow pulse, were almost as acute as those of the group under 30 years of age who were infected with a highly toxigenic organism. Moderate icterus of the skin or sclerae was present in all these cases. Urinary incontinence was not present, but retention was noted in all the subjects. The staphylococci isolated from all of these subjects produced a moderate amount of toxin.

#### OBSERVATIONS

The separation of cases of staphylococcal infection with invasion of the blood stream into the two large divisions described appears to be justified by its correlation with experimental findings. It has been shown that the intravenous injection of potent staphylococcal toxin into a susceptible animal is followed by a characteristic train of hyperacute manifestations terminating rapidly in the death of the animal. This chain of events may be duplicated, but in slower sequence, through the intravenous injection of a toxin-free suspension of a highly toxigenic strain of staphylococcus, in which case the toxin is elaborated *in vivo*. These animals die within a relatively few hours with no evidence of localization of the infection. The same chain of events took place in the children dying in the Bundaberg disaster. They were also seen in the series here described in the subjects under 30 years of age who were susceptible to the effects of

toxin. The speed of development and intensity of the symptoms varied almost directly with the potency of the toxin produced by the infecting staphylococcus. It should be remembered that different strains of staphylococci produce different amounts of toxin. Therefore, should a subject who is susceptible to the effects of toxin be infected by staphylococci producing a toxin of moderate potency, the symptoms would at first be those of mild toxicity. As the infection developed, the symptoms referable to localization would be added to the picture, and a combination of the two may be sufficient to cause death.

Symptoms of toxicity do not appear following the intravenous injection of a nontoxigenic staphylococcus into a susceptible animal. Several days are required to kill the animal, and death is due to multiple abscess formation. Such was the usual course of the disease in the patients over 30 years of age who had become infected with a nontoxigenic staphylococcus and who died.

When experimental animals are protected by the administration of staphylococcal antitoxin and injected with a highly toxigenic organism, the effects of the toxin are not apparent, and the course of the infection depends upon the organism itself. Clinically this was seen after intensive early antitoxin therapy in a child who survived an infection by a highly toxigenic staphylococcus. It was also seen in the subjects over 30 years of age who were infected by toxigenic staphylococci. Although these subjects were resistant to the effects of toxin, they all showed evidence of infection by the organism itself. However, this infection was fatal only when their general condition was so poor that they could not resist it.

The 3 fatal cases of recurrent osteomyelitis with invasion of the blood stream deserve special emphasis. Their marked clinical and bacteriological resemblance indicates that some underlying factor plays a part which is not fully understood. The question is raised why young adults otherwise in good health who have had their infection for many years and who have been able to overcome several recurrences, should suddenly lose all resistance and die.

given adequate early staphylococcal anti-toxin therapy which apparently neutralized the effects of the toxin.

Postmortem examination of the patients showing the greatest effect of toxin revealed that the local lesion was small, or else none at all could be found. Metastatic areas of infection when present, were in a very early stage and small, being more often of the nature of infected infarcts than true abscesses. Hemorrhagic lesions of the myocardium, skin, and gastro-intestinal mucosa were often present. Gastro-intestinal lesions were present in 4 cases, ranging from nonspecific congestion of the mucosa to definite hemorrhagic necrotic lesions of the colon. Areas of nonspecific focal inflammation of the myocardium and renal cortex were occasionally found.

Postmortem examination of those patients showing less effects of toxin revealed more evidence of the development of suppuration throughout the body.

**Toxin resistant group.** Fifteen patients showed none of the symptoms attributable to the effects of toxin. All were over 30 years of age with the exception of 1 boy who was 16 years old. The usual history was that of some local infection which gradually increased in severity until invasion of the blood stream occurred. Gastro-intestinal symptoms were not severe and consisted of abdominal distention, vomiting and diarrhea. None of these patients showed signs of meningeal irritation; most of them were apathetic, drowsy and irritable but were mentally clear when aroused. While anemia was usually present, it depended upon the duration of the illness, rather than on the immediate severity of the disease. As before indicated the total and differential white blood counts, the index of toxic granulations of the neutrophils, and urinalysis showed nothing unusual. Both the temperature and the pulse were elevated throughout the illness but the pulse rate always remained in proportion to the height of the temperature. The course of the disease was prolonged, and in the fatal cases it averaged 66 days.

Of these 15 cases, 6 (40 per cent) were fatal. The average age of these 6 patients was 57.8 years. All were chronically or sub-

acutely ill, and all had some predisposing or intercurrent illness which rendered them more susceptible to staphylococcal infection. The patients died with evidence of generalized infection. Of the strains of staphylococci causing these infections, 2 were highly toxigenic, but the 4 others produced little or no toxin.

For the most part the survivors in the toxin resistant group who averaged 40.1 years of age were in good general condition prior to the onset of their infection.

An apparent discrepancy exists between the clinical findings in this group and the toxigenic capacity of the staphylococci isolated from these patients. All of these strains produced potent toxin although the patients did not show symptoms which could be attributed to its effect. Apparently therefore some resistance to the effect of toxin existed, although at present it cannot be accounted for on any experimental basis.

**Miscellaneous cases.** The 6 remaining cases exhibited special characteristics which exclude them from the other groups described. Three of these represented infections involving some vital organ. In each instance there was terminal invasion of the blood stream, and the symptoms throughout the course of the illness were primarily those referable to the local involvement. Two of these cases represented infections of the central nervous system, a brain abscess in one instance and a meningitis in the other. The third was one of suppurative phlebitis of the portal vein, with multiple liver abscesses. The patients were all adults ranging from 24 to 33 years of age. Both temperature and pulse were elevated and they remained in close proportion to each other. Blood counts and urinalysis revealed nothing significant. The course of the disease was protracted and ended fatally in each case. In both infections of the central nervous system the causative organism was a highly toxigenic staphylococcus. In the case of phlebitis of the portal vein, the staphylococcus was not at all toxigenic.

Three cases of recurrent osteomyelitis with invasion of the blood stream presented re-

The illnesses in question included diabetes mellitus, syphilis and chronic nephritis, severe arthritis about the hip joint of one, fracture of the femoral neck in patient with hyperparathyroidism, hyperparathyroidism and diabetes mellitus, and severe focal phlegmon accompanied by paronychia.

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## PREPARATION AND PRESERVATION OF STERILE CITRATED BLOOD PLASMA BY THE AMPUL TUBE METHOD

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CURRENT experimental and clinical publications reveal an increasing interest in the therapeutic use of preserved blood plasma (6, 8, 15, 19, 25, 26, 28, 29). The present communication concerns itself with the description of a procedure whereby sterile citrated blood plasma may be separated and preserved, which, the writer feels, may offer certain advantages over methods now commonly employed for the purpose (7, 8, 11, 12, 15, 21, 23, 24, 25, 26, 27).

As has been pointed out elsewhere (25), some confusion has arisen in the literature due to the failure of a few investigators to distinguish clearly between blood plasma and blood serum. Blood plasma, as the term is to be employed here, denotes that fraction of the blood remaining after sufficient anticoagulant has been added to prevent clotting and after all cellular elements have been removed. Blood serum is the residual portion of the blood after clotting has occurred and the clot together with all remaining cells has been removed (3, 25). Particular attention has been devoted to preserved blood plasma as a therapeutic agent for the following reasons:

1. No typing or cross-matching processes are necessary preliminary to its use since re-

moval of the cells eliminates the dangerous agglutination factor (6, 8, 25, 30).

2. It can be used after much longer periods than preserved whole blood which progressive hemolysis eventually renders unfit for clinical employment (4, 6, 8, 9, 21, 23).

3. It does not produce such untoward reactions after administration as are occasionally reported following the employment of blood serum which may be changed by the clotting process (25).

4. In certain conditions it is a more rational therapeutic vehicle than whole blood, and is an excellent substitute when the latter is indicated but not immediately available (3, 19, 23, 25).

The conditions in which intravenous plasma administration is indicated are among those for which fresh or preserved whole blood has been until recently almost exclusively employed, namely decreased blood volume (5, 16, 19, 25, 26), hypoproteinemia (1, 2, 10, 18, 20, 22, 25, 28, 29), and states in which it seems advisable to attempt the transfer of immune bodies which may be present in the plasma (3, 12, 14, 25). Consideration of the growing therapeutic possibilities (8, 25) of preserved blood plasma has prompted the writer to present the procedure outlined below in the hope that it may aid in extending and facilitating its use.

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## CONCLUSION

On the basis of the series of cases of staphylococcal infection with invasion of the blood stream here described it would appear that it is possible to determine from the clinical characteristics alone whether the symptoms are primarily those due to the effect of staphylococcal toxin or those due to the staphylococci themselves. In human beings under 30 years of age highly toxigenic staphylococci cause a disease which is hyperacute and rapid in its course. Characteristically the pulse rate is very high and out of proportion to the height of the temperature. Symptoms of irritation of the central nervous system and of the gastro-intestinal tract predominate. There is a marked increase in the number of non-segmented polymorphonuclear neutrophilic cells in the circulating blood.

Individuals over 30 years of age are not affected by the toxin, but are still affected by the organism itself. The course is not so rapid, nor so acute and the symptoms are those arising from the foci of infection, plus a gradual degeneration of body processes as is seen in long standing illness in general. The prognosis in this group depends on the health of the patient prior to his infection, and on the location of the local or metastatic foci. In this group death resulted only when predisposing or intercurrent illness rendered the patient more susceptible to the staphylococcal infection or when the infection attacked some vital organ or a region that could not be drained.

Individuals resistant to the effects of the toxin are still subject to the infectious process caused by the organism, regardless of whether this resistance has been induced by antitoxin, or is natural as in the subjects over 30 years of age.

Staphylococcal infection of the blood stream in subjects with recurrent osteomyelitis, although an infrequent complication is of considerable significance and in this series was always fatal.

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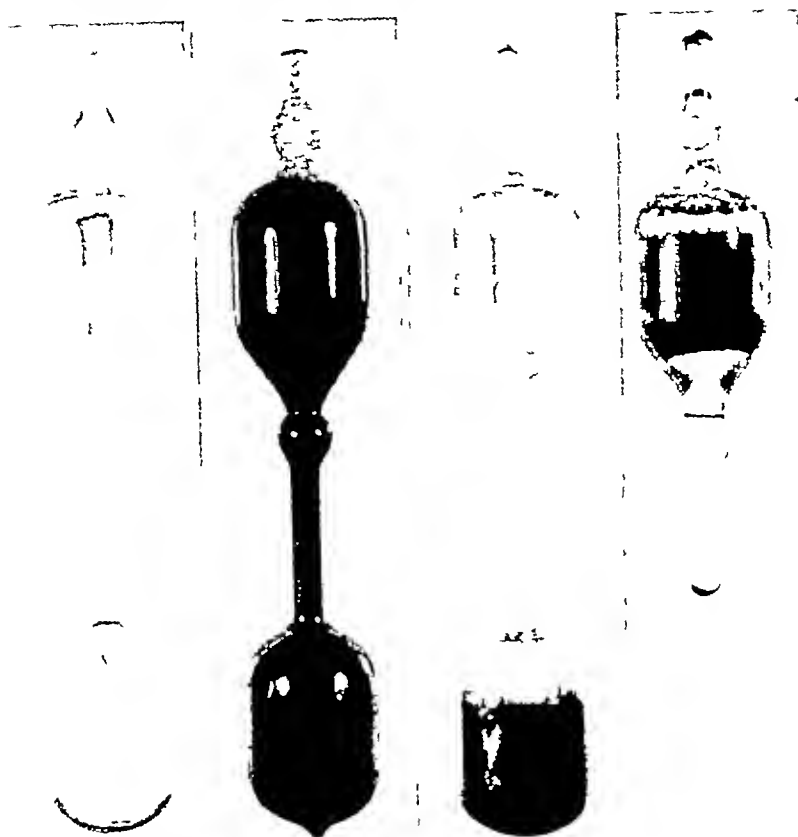


Fig 7 Photographs of tubes in process of preparation

the extreme open end in a hot oxygen gas flame and rotating it to ensure even closure, sealing is complete in about 20 seconds. No heat is transmitted to the upper chamber containing the citrated blood because of the poor heat conductivity of the glass and the long ampullated neck (Fig 3). The sealed end is allowed to cool completely and the tube is placed in a centrifuge and rotated at 1,000 revolutions per minute, for 30 minutes. At the end of this time, the blood cells (50 per cent of the filled volume) have settled into the lower chamber leaving the supernatant plasma in the connecting piece and upper chamber (Fig 4).

The tube is then removed from the centrifuge taking care not to disturb the cell plasma interface and placed upright in a sterilizing solution of 70 per cent alcohol for 30 minutes. The tube is subsequently taken from the al-

cohol and the latter allowed to evaporate from its surface. The connecting piece is scored with a sterile file at a point above the packed cells in the lower chamber. The lower chamber containing all the cells and usually a small portion of the plasma (1 to 5 cubic centimeters) is cracked off. The remaining portion of the tube (connecting piece, upper chamber, and sealed upper neck) containing the pure plasma is inverted and the plasma allowed to settle to a level below the ampulla of the connecting piece. At this point a few drops of sterile isotonic saline is used to wash the remnants of the plasma from the walls of the connecting piece into the chamber. The open end is then fire-sealed in the manner previously described. The result is an hermetically sealed all glass ampul containing approximately 150 cubic centimeters of sterile blood plasma (Fig 5). Ampuls prepared in this

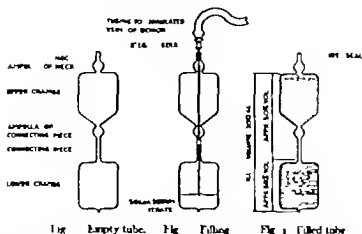


Fig. 1 Empty tube. Fig. 2 Filling. Fig. 3 Filled tube.

The glass container herein described as an essential part of the method is apparently new since a search of the literature has revealed no description of a similar apparatus for the purpose designated. This container consists of a glass tube of 300<sup>1</sup> cubic centimeters filled volume capacity made in two compartments with a narrow ampullated connecting piece and an open ampullated neck of the same inside diameter (4 millimeters) as the latter attached to the upper chamber (Fig. 1). The tube is so constructed that the lower compartment contains approximately 50 per cent of the filled volume and the connecting piece and upper chamber to the filling level the other 50 per cent (Fig. 3). The glass employed in the construction is thin and of low melting point to facilitate fire-sealing.

Under sterile technique sufficient sodium citrate (50 cubic centimeters, 2.5 per cent

sodium citrate to 300 cubic centimeters of blood) is placed in the bottom chamber of the sterilized tube to prevent coagulation. Blood from a suitable donor is then allowed to pass directly into the glass tube by means of standard rubber tubing connected with a long large caliber needle (No. 13 gauge length 8 inches) placed through the open neck upper chamber and connecting piece into the lower chamber containing the sodium citrate (Fig. 2). As the blood flows into the glass tube the latter is gently rotated and shaken to cause mixing with the citrate. In this way the tube is gradually filled to a point in the upper chamber just below the ampullated portion of the open neck (Fig. 3). When this level is reached the needle is withdrawn and the blood adhering to the open neck is washed into the upper chamber with a few drops of sterile isotonic sodium chloride. The neck is then carefully fire-sealed by holding

cautiously of larger volume are practical.

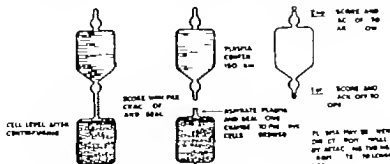


Fig. 4 Centrifuged. Fig. 5 Sealed ampul. Fig. 6 Opening.

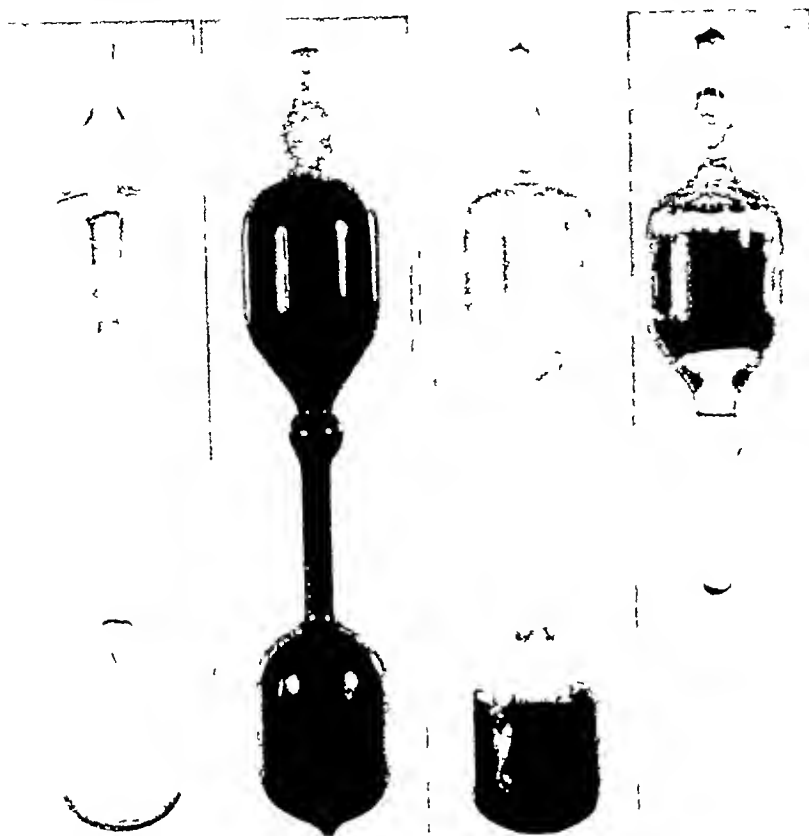


Fig 7 Photographs of tubes in process of preparation

the extreme open end in a hot oxygen gas flame and rotating it to ensure even closure, sealing is complete in about 20 seconds. No heat is transmitted to the upper chamber containing the citrated blood because of the poor heat conductivity of the glass and the long ampullated neck (Fig 3). The sealed end is allowed to cool completely and the tube is placed in a centrifuge and rotated at 1,000 revolutions per minute, for 30 minutes. At the end of this time, the blood cells (50 per cent of the filled volume) have settled into the lower chamber leaving the supernatant plasma in the connecting piece and upper chamber (Fig 4).

The tube is then removed from the centrifuge taking care not to disturb the cell plasma interface and placed upright in a sterilizing solution of 70 per cent alcohol for 30 minutes. The tube is subsequently taken from the al-

cohol and the latter allowed to evaporate from its surface. The connecting piece is scored with a sterile file at a point above the packed cells in the lower chamber. The lower chamber containing all the cells and usually a small portion of the plasma (1 to 5 cubic centimeters) is cracked off. The remaining portion of the tube (connecting piece, upper chamber, and sealed upper neck) containing the pure plasma is inverted and the plasma allowed to settle to a level below the ampulla of the connecting piece. At this point a few drops of sterile isotonic saline is used to wash the remnants of the plasma from the walls of the connecting piece into the chamber. The open end is then fire-sealed in the manner previously described. The result is an hermetically sealed all glass ampul containing approximately 150 cubic centimeters of sterile blood plasma (Fig 5). Ampuls prepared in this



manner are stored in 70 per cent alcohol until required.

Strict aseptic technique is essential in carrying out the procedure described. Proper sterilization of all apparatus, particularly the glass tubes, is emphasized. Glass subjected only to boiling occasionally shows contamination with the *Bacillus subtilis*. Adequate steam pressure sterilization (20 pound pressure for 30 minutes) avoids this possibility.

The initial filling of the tube to the proper level is important (Fig. 3). The citrated blood must be kept at a level well below the ampulated portion of the open neck. At a higher level, the heat from the sealing process may cause coagulation. The fire-sealing of the open neck and connecting piece requires some mention. The neck and connecting piece must be free from blood or plasma above the fluid level (accomplished by washing down their inside surfaces with a few drops of sterile saline) otherwise the heat may cause charring and discoloration. If this precaution is observed, no difficulty in fire-sealing will be encountered. A hot flame preferably from a gas-oxygen blow lamp tilted horizontally is necessary. Rotation of the tube on its vertical axis with its tip in the flame ensures an even closure denoted by the appearance of a solid white hot glass bead completely covering the tip. The process of removing the contents of the ampul for use is simple. Under sterile technique the ampul is taken from the sterilizing alcohol solution and the latter allowed to evaporate from its surface. The projecting tubular ends of the ampul (sealed connecting piece and sealed neck) are scored with a sterile file and cracked off one after the other. This process allows free ingress of air into the ampul and the plasma is rapidly evacuated (Fig. 6). The plasma can then be filtered and administered by the ordinary apparatus employed in indirect citrate transfusions. It may also be given directly from the ampul by connecting the intravenous tubing directly. In this instance a filter is placed below the suspended ampul and the plasma is filtered as administered.

Properly prepared these ampuls of plasma can be kept almost indefinitely since the plasma proteins undergo little alteration (23

24, 25). The immune bodies contained in the globulin fraction retain potency for at least 30 days in preserved plasma (8, 12, 21, 23, 25).

Considerable variation in lipid content of the plasma occurs (8, 25). Blood plasma taken shortly after donor has ingested food tends to make the plasma less clear and of greater viscosity. Increased lipid content is, however, no contra-indication to its use. Upon standing in the ampuls for some time small deposits of a white substance, presumably fibrin, may settle out. This may be readily filtered out by ordinary methods when ready for use.

#### ADVANTAGES OF METHOD

1. The plasma remains throughout the preparation process in its original container reducing the chance for contamination.
2. The ampuls of plasma prepared in this way present all of the desirable features of any therapeutic agent prepared in ampul form, among which are ease of sterilization, convenience in transportation and storage and ease of administration.
3. The process is not expensive. With the exception of a few special articles, the glass ampuls, large caliber needles, and over-sized transfusion cups, the procedure can be carried out with standard hospital equipment.

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# CLINICAL SURGERY

## WEBBED FINGERS

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**O**VER one hundred articles dealing with either webbing of the fingers or the toes have been written during the past 25 years. Most of these contributions are based on a study of one or two cases and only a few is a large series reported. The major publication in the English language is by Davis and German, who reviewed the subject thoroughly in 1930. The author is in agreement with the principles outlined in this latter paper but feels that after an elapse of 10 years, certain fundamentals of the operative treatment need re-emphasis and there need slight modification to insure uniformly good results.

This paper is limited to a report of 73 cases of congenital webbing between the fingers or between the fingers and thumb. It does not include a study of other abnormalities, such as polydactylism, agenesis of the fingers, split hand, etc., unless these abnormalities are associated with abnormal fusion or webbing.

### EMBRYOLOGY

Bardeen and Lewis (1917) in 1901 published such complete studies of the embryology of the extremities that there have been few contributions since then that have surpassed them. It is known that the upper limb buds appear at about the third week of fetal life. The distal portions of each bud soon flatten out to take the shape of flippers or flat, circular fins on short, fat rounded stalks. The mesodermal elements in the stalk rapidly differentiate into pre-muscle masses and three condensed cell groups that later become the humerus, radius, and ulna. Concomitant with these changes in the stalk the mesoderm in the hand plate begins to differentiate into the anlagen of the carpal bones. By this time a set of border clefts has formed at the outer rim of the hand plate. These will later become the superficial and deep palmar arches. Peripheral to these border clefts and supplied by branches from them, five more condensation areas appear. These be-

come the fingers and thumb. By the fifth sixth week of fetal life the condensation areas of the hand plate have grown so much more rapidly than those in the stalk that short but definite finger-like projections are seen, still united to each other by thin sheets of tissue or webs. If there is an arrest in development at this stage, the child at birth will have a completely fused hand, usually smaller than normal and with deficiencies in development of the carpal bones (Figs. 1 and 2).

Between the sixth to seventh week of fetal life the finger buds grow more rapidly than any other portion of the appendage. Cartilaginous metacarpals and phalanges appear soon followed by tendons, ligaments, joints, and intrinsic muscles. Because the growth of the finger buds is so much more rapid than the tissue between them, the webs become less and less marked until finally the only remnants left are the webs that exist on the palmar surface of normal hands. If there is a temporary arrest in development during the seventh or eighth week of fetal life this disproportionate rate of growth will not occur. It is then quite possible for two or more fingers to be momentarily retarded in growth and to remain united by the webs. Later in fetal life growth both of the finger buds and of the webs between them, takes place at an even rate so that at birth, even though the fingers may have attained proper length, the webs will still be present and of the same length as the fingers.

The growth of the limb stalk is much slower than that of the hand so that in early fetal life almost completely formed hand protrudes from very much foreshortened arm. Numerous examples of arrests in development at this stage have been seen when a fairly normal hand projects either directly from the shoulder girdle or from a very short, stiff arm composed of rudimentary portions of the humerus, radius, and ulna (Fig. 3).

### OCCURRENCE

A summary of reports previously published on this subject makes it appear that webbing of the toes or fingers occurs in a ratio of 1 in 2000 to 1 in 500 births. Of all the congenital anomalies, this

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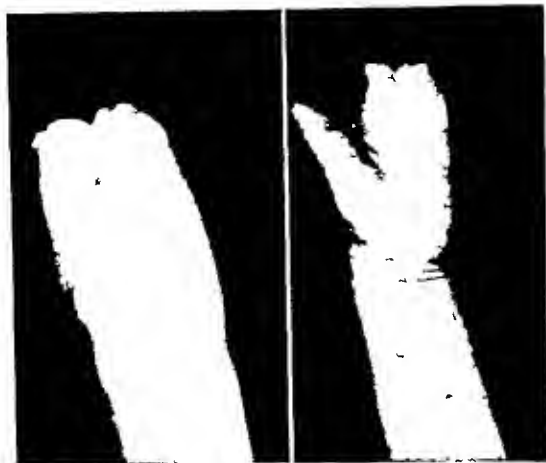


Fig 1, left Example of a completely fused hand. There are deficiencies in development of the carpal bones and the phalanges are all shortened

Fig 2 The thumb has been freed as the first stage of the repair. Subsequent operations will free the other digits. Movement of the thumb is normal

particular one seems to demonstrate the inheritance factor more frequently than many others. Straus, studying his own cases and those in the literature with reliable pedigrees, outlined four different modes of inheritance with examples of each (1) as a Mendelian dominant (2) as a Mendelian recessive in generation I but arising in generation II, being thus a mutation or sex-linked dominant (3) as a Mendelian recessive but not arising in generation II thus being a sex linked recessive (4) as a sex-linked character.

It may be concluded from the various heredity studies that the occurrence of webbing almost always follows from one generation to the next (except as in 3 above). It seems to occur more frequently in males and in their descendents. Davis and German report from the literature 63 per cent males to 37 per cent females and in their own series of 50 cases, 68 per cent males to 32 per cent females. In this series of 73 cases the ratio was 66 per cent males to 34 per cent females. Our records also showed that in 48 per cent of the cases both hands were affected and in 35 per cent the toes were also webbed.

#### TYPES OF WEBBING OF THE FINGERS

The least deforming and simplest type of web is represented by a slightly higher attachment of the normal web between two or more fingers. This is very seldom noticed during normal motion of the hands and causes annoyance to the patient only when he tries to fit gloves or perform



Fig 3 Example of an arrest in development of both limb buds. Note the rudimentary hand on the short, flail arm. This patient uses his feet for writing, eating, etc.

acts requiring extreme fanning of the fingers such as is required in playing the piano. When the web is attached at, or distal to, the level of the proximal interphalangeal joint it becomes a distinct physical and psychological handicap.

The web may be composed of only skin so that it forms a shelf of tissue that may be picked up between the operator's fingers. This type is amenable to stretching and massage as a pre-operative routine so as to widen the gap between the fingers and thus increase the amount of skin available to cover the raw surfaces after separation. Frequently the union is so close that the two digits are not even demarcated by a crease but have a wide, single finger nail and perfectly smooth dorsal and ventral surfaces continuous and common to each. In some fusions a central set of vessels and nerves may be common to each finger. Occasionally one or more of the bony phalanges are fused, the most frequent being the distal one. Frequently this bony fusion is accompanied by a common interphalangeal joint. Due to the fact that there are no lateral ligaments for support of the joint on the separated surfaces this latter type of deformity presents the most difficult surgical problem in preserving the straightness of the fingers after separation.

The persistence of these webs is most commonly found between the third and ring fingers of one or both hands. Various combinations of fusion be-

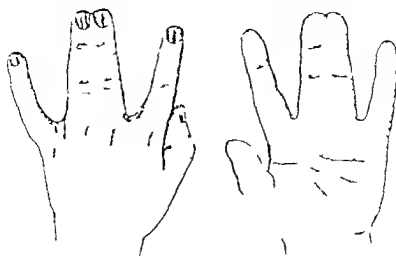


Fig. 4. Draw. ing showing the most common type of foetal.

tween the second, third, and fourth fingers are found and occasionally the thumb is also involved to form a completely solid hand, not much differentiated except in size from the embryological flipper-like hand plate (Fig. 1).

#### OPTIMUM TIME FOR OPERATION

When the web is loose enough to fan out as the fingers are separated, it seldom has any effect on the rate or direction of growth of the bones. In cases with this type of deformity it is then advis-

able to postpone correction until the child is old enough to co-operate with the dressing, exercises and massage all of which are necessary to provide a good operative result. It is also advisable to operate before the attention of playmates to his deformity causes him embarrassment. The optimum time for operation in this group then falls between 6 and 7 years of age.

When the fingers are tightly united by skin with or without bony fusion, it will be noticed that the fingers involved are nearly always of the



Fig. 5. Triangular flaps of tissue have been reflected down without injury to the circulation of the flaps. Note that the palmar flap is narrower and shorter than the one raised on the dorsal surface. The dotted line indicates the point of separation of the rest of the fingers.

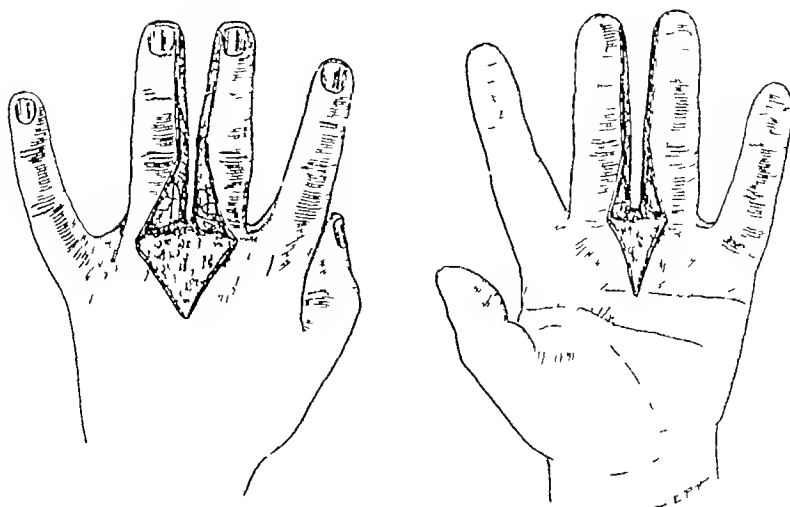


Fig 6 The fingers have been separated along the line of fusion leaving a raw surface on each finger

same length (Fig 8) A casual glance at a series of normal hands will demonstrate the variations in length of the fingers on the same hand, the two hands of the same person and of different people. The important fact to note is that there is a variance. Consequently, in order to effect as nearly a normal hand as possible in people with this type of webbing, operation must be done at an early age. To operate on a baby with tightly fused fingers in the first two years of life exacts the ultimate of patience in the surgeon both during the operation and later as he daily tries to bandage tiny, wriggling fingers. Any attempts at a con-

certed type of exercise is lost. Frequently, a successful operative result is ruined by lack of cooperation from the patient, during the important period of splinting, exercise, and massage. Considering these drawbacks, operation in this group should seldom be done under 2 years of age or postponed longer than 4 to 5 years of age. If operation is done within this period, the finger which, in a normal hand would have been longer than the one fused with it, will, as a rule, grow at a faster rate so that the variance in length characteristic of normal fingers is soon apparent (Figs 8 and 9).

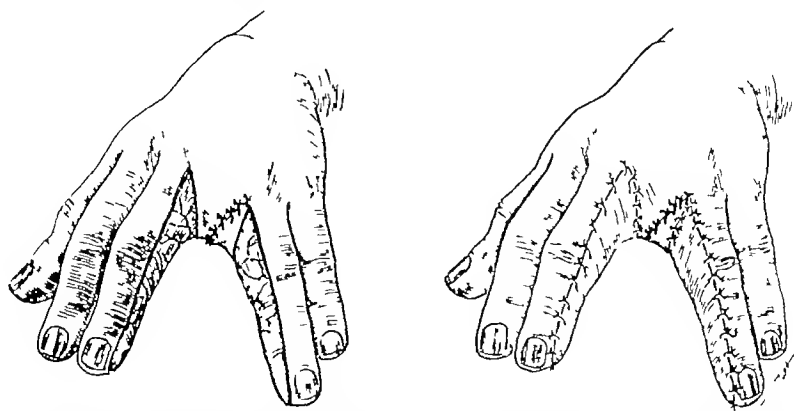


Fig 7 The flaps are drawn through the commissure and sutured to each other by subcutaneous sutures of No 0000 plain catgut and a row of No 000000 dermic to the skin along the central bar of the Z. The right hand drawing shows the raw surfaces covered by thick razor grafts which are held in place by numerous sutures of No 0000 plain catgut.

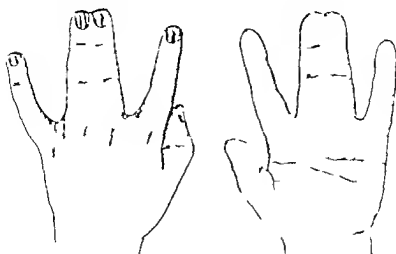


Fig. 4. Drawings showing the most common type of fusion.

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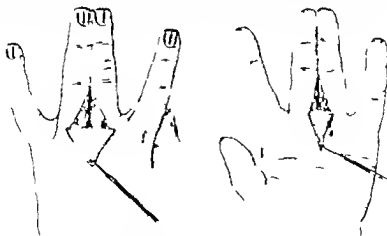


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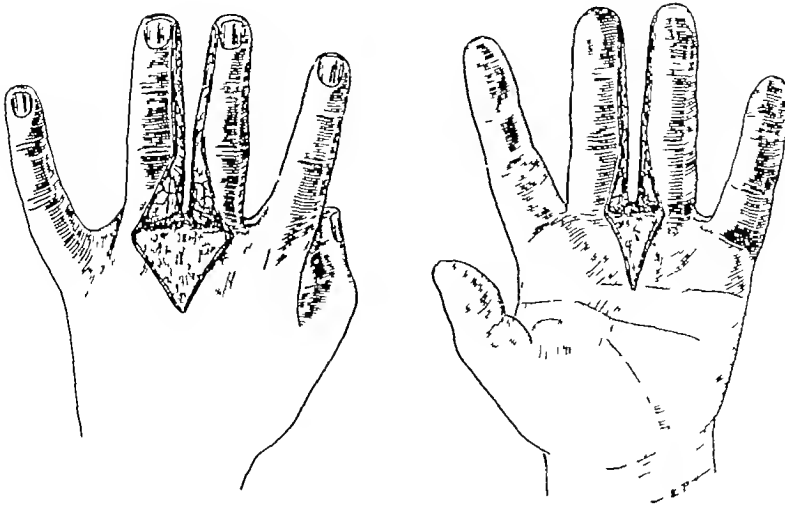


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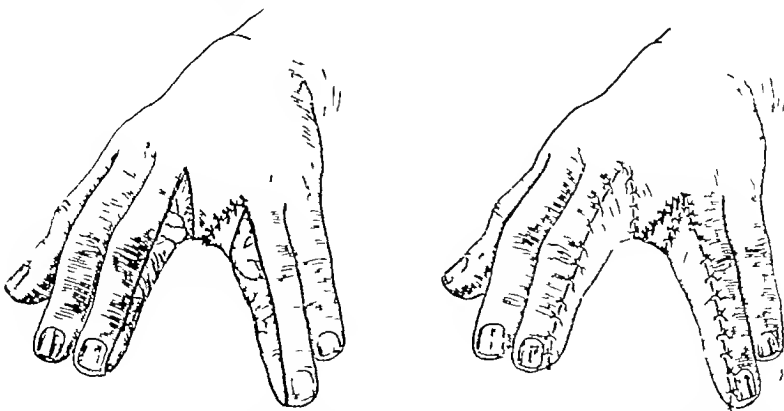


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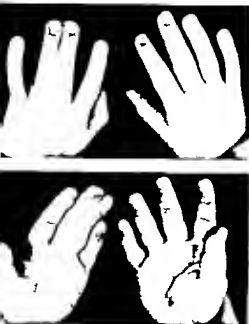


Fig. 8. Pre-operative photographs of fusion of the third and fourth fingers on the left hand. Note that these fingers are the same length.

#### TYPE OF OPERATION

Whenever any condition requiring surgery for correction is able to be remedied by a dozen or more different types of operation, it usually follows that each method leaves something to be desired. Such is the case with webbed fingers. The various methods for correction of this deformity may be divided roughly into two main groups.

Those that utilize the available skin in the web to cover the raw surfaces on the fingers after separation.

Those that advocate the transfer of skin from a more distant site to close the raw surface great to be covered safely by skin flaps formed in the webs.

In the first group belong the plans of early workers who simply cut down the center of the web and bandaged the fingers apart until the raw surface epithelialized. This procedure was not very successful and frequently was followed by marked flexion contractures of the fingers, and recurrence of the web.

After Dieffenbach, and Norton added varied flaps cut from either the back of the hand, the fingers, the front or both, and sewed them in the commissure. This was a distinct improvement over the previous methods as the web

did not reform. The closure of the raw surfaces on the fingers was either by direct suture, which was often under too much tension to heal, or by epithelialization without suturing.

To meet the problem of distortion of the fingers from the excessive scar tissue caused by secondary healing Didot, Dixday and Watson all independently described the same type of operation, the first two long before the latter. This operation is the one most frequently used today, most frequently quoted in textbooks, and probably gives uniformly the poorest result of any of the operations described, except for those rather rare cases in which there is an abundance of skin in the web. The principle of this operation was to raise two short, broad flaps, one with its pedicle extending the full length of the dorsal surface of one of the fingers and the other with its pedicle extending the full length of the palmar surface of the other finger. After these flaps were raised the soft parts were divided along the line of fusion, all the excess subcutaneous tissue trimmed away and then each flap wrapped around the finger to which it was attached and sutured. This procedure has several disadvantages. First it does not produce a good web at the base of the commissure so that a second operation is often necessary to correct this. Second, the long edge of the dorsal flap is wrapped around and sutured near the midline on the flexor surface of one of the fingers. Flexion contracture usually occurs along this line with healing and is difficult both to avoid and to overcome. Third there is seldom enough tissue in the web between the two fingers to produce flaps of adequate length so that closure of the defects on the fingers will not be under tension. When tension does exist, it may be great enough to cause either gangrene of the fingers or to split the suture line. In the latter case the formation of scar tissue is usually sufficient to distort the fingers.

To the list of men already mentioned may be added the names of many more each offering a slight modification in the shape and position of the various flaps that could be made. Most of the methods outlined work out better on paper than in actual practice and some differ not at all with work previously reported. Finally surgeons who had the opportunity to operate on a series rather than isolated cases realized the shortcomings of most of these complicated flap procedures and began to use skin grafts to cover all the raw surfaces. The results obtained were as a rule better than those resulting from the flap methods but frequent drawback was the contracture of the graft, which caused not only the recurrence of the web to a varying extent but also distortion of the

fingers The natural outcome of this was the final adoption of some type of flap or flaps to form the commissure and if there was not an abundance of skin on the fingers, the utilization of a graft to cover the surface left denuded by the separation.

The cases in this series have run the gamut of nearly all the methods with varying degrees of success depending upon the judgment and ability of the surgeon. This has led to the conclusion that, of all the methods advocated, there is probably only one that could be used in almost every case with fair insurance of a good functional and cosmetic result. If this operation had to be named it might be called either Elchizet's or Norton's modification of Zeller's operation with the addition of either a thick razor graft or a full thickness graft to close the defect on the fingers. Because of its broader application, it is felt that more detailed description of this method is justifiable.

#### PRE-OPERATIVE PREPARATION

Several thorough scrubblings of the hands with soap and water should be carried out during the 48 hours preceding repair. The nails must be clipped as short as possible and the cuticle freed and softened. In older individuals if the palm at the base of the fingers is heavily calloused, this should be trimmed away with a sharp razor and the remainder softened with an oil and glycerine mixture. It is a wise precaution to have photographs taken for later comparisons.

#### OPERATION

The plan of incision should be outlined on the fingers with either sterile ink or scratch marks. It will take the form of an inverted Y on both the palmar and extensor surfaces of the fingers. On the dorsum, the incision extends along the line of fusion from the tip down to a point just proximal to the proximal interphalangeal joint. Here the line splits so that each bar runs to a spot directly over the center of the metacarpophalangeal joints of the fingers involved. These bars outline a V shaped flap which is carefully raised without injury to its circulation (Fig 5). On the palmar surface the incision extends from the tip down to a point just proximal to the proximal interphalangeal joint. Here the line divides again into two bars to outline another V shaped flap, smaller in size than the one on the extensor surface and having a base level no lower than the base of any of the other normal webs on that hand (Fig 5). This flap is also freed from its underlying tissue without injury to the circulation. After sufficient mobilization these two flaps are then drawn through the

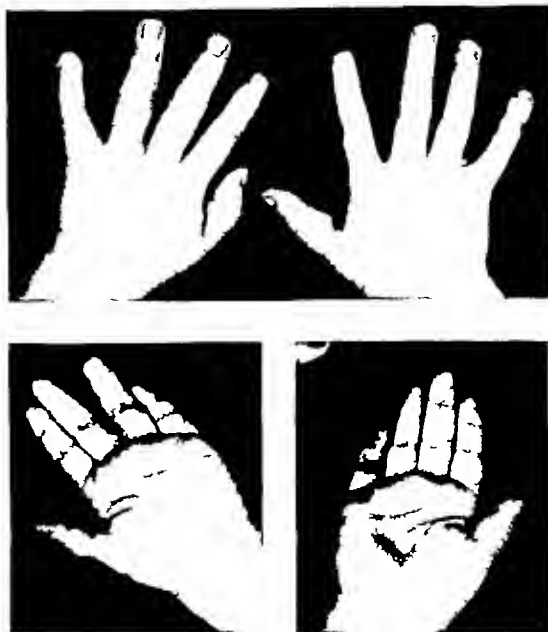


Fig 9 Postoperative photographs taken 1 year after separation of the fingers. Notice that the web between the separated finger is at the same level as the other webs and also that the third finger has grown longer than the fourth.

commissure and sutured side by side in the form of a "Z" (Fig 7). The suture material used in this clinic is No 0000 plain catgut for the subcutaneous tissue and No 00000 dermic or fine silk for the skin. Hemostasis is best achieved by digital pressure at the base of the fingers by the first assistant. Hot packs under continued pressure and as few ligatures as possible are advocated in preference to the often advised tourniquet. Subsequent edema and hidden hemorrhage contraindicates the use of the tourniquet.

After hemostasis is absolute, two thick razor grafts are cut from the thighs and sutured under very slight tension over the raw surfaces on the fingers. The suture material should preferably be a No 0000 plain catgut. As in the case of all razor grafts to the hand or foot, the approximation of the graft with the normal skin should be uniform and complete without any overlapping (Fig 7). If overlapping is allowed, maceration may occur along the line of junction and delay the healing by first intention. When the grafts have been sewed into place, irrigation beneath them with warm, normal saline will dislodge any possible collection of serum or blood. Some surgeons prefer the use of a full thickness graft in this site. The end-result is practically the same except that

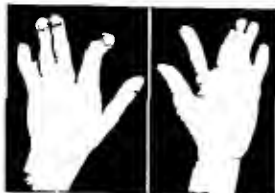


Fig. 1. Pre-operath photographs showing complete fusion between the third and fourth fingers and partial fusion between the fourth and fifth fingers. The curvature of both the first and fifth finger is due to ridge shaped middle phalanx and is unrelated to the clubbing.

the thick razor graft is easier to cut and to handle and has correspondingly less chance of failure to take.

The dressing must be applied immediately after the irrigation has been completed. Strips of tulle gras are first placed over the grafts. Fokked strips of fine gauze soaked in acriflavine 1:5000 are then wrapped securely around each finger. Over this are placed several layers of plain dry gauze and possibly a layer of rubber sponge to produce even, firm pressure on the grafts. It has been found that the dressing becomes so unwieldy with the

Wick method gauze impregnated with vasoline 99 percent composed (surface of benzole 9 percent and undecylol for 5 minutes under 30 pounds of pressure.

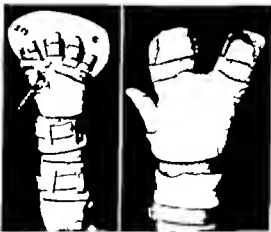


Fig. 2. Photographs of the types of splints which are used following separation. The one on the left is used in case rib and/or web has while that on the right is used when only one rib has been separated.

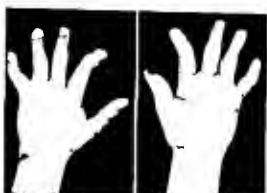


Fig. 3. Postoperath photographs taken 6 months after separation of all fingers. The curvature of the fingers all be corrected at later time by ridge shaped osteotomy.

application of rubber sponge to small fingers that often better pressure can be secured with the use of several layers of plain gauze held in place by elastic bandages.

The hand is then placed on a padded V shaped wooden splint which has previously been cut to fit the hand in vol ed. The splint extends from just below the elbow to point about an inch beyond the finger tips. The splint is placed on the dorsal surface of the forearm and a pad is placed between it and the back of the wrist to give a slight dorsal angulation of the hand. The V shaped splint at the end of the splint should be cut to fit exactly the new commissure made between the fingers. Pressure over the dressing is attained by strips of narrow elastic adhesive (elastoplast) over which are placed elastic bandages (are vic) both applied so that at least one or two finger tips may be inspected for circulation without disturbing the rest of the dressing. Material such as plaster cast, etc. may be used for splinting but it has been the experience in this clinic that wooden splints are neater lighter cheaper and less easily displaced by the child. The entire arm is then placed in sling so that the elbow is bent at 45 degree angle rather than the usual 90 degrees. This is for comfort only as postoperative congestion from dependency is thus eliminated.

#### POSTOPERATIVE CARE

The dressing is first removed on the eighth day after operation. It will be found that the gauze which had been soaked in the acriflavine will be dry and quite stiff so that soaking the hand in sterile saline will help in the removal of the dressing. The sutures used to tack down the graft will have disappeared and only those across the central bar of the Z in the commissure will need re-

moval A dressing identical to the first is applied and changed every 2 to 3 days By the fourteenth day gentle massage of the grafts may be started, a bland ointment or oil being used Both active and passive motion under water is also begun at this time

At the end of the third week the patient is fitted with a more permanent type splint which will be worn for 6 months These splints are made of aluminum, reinforced with light steel bands and covered with glove leather If only one web is involved it is Y shaped at the distal end (Fig 12) If more than one web has been repaired the end of the splint takes the shape of a flat rounded, perforated plate through which leather straps are run to hold the fingers flat to the plate and spread to their maximum extent (Fig 12)

The importance of long splinting cannot be overemphasized All razor grafts placed in a position where they are not continually stretched must go through a period of contracture within the first 6 months after their application Unless continued splinting to keep them at their maximum size is employed, they tend to become contracted more than would be consistent with a good result

During the first 4 postoperative months the splint is worn at all times except for two periods in the day of 30 to 60 minutes each During these periods the hand is first soaked in very hot water for 5 to 10 minutes It is then massaged with coco butter or a mild, thin oil After the massage the patient does a complete set of finger exercises planned to build back the strength of the forearm muscles and to stretch the fingers to the limits of their motion From the fourth to the sixth month, in addition to the two exercise periods, the hand is released during meal time or on special occasions lasting not longer than an hour By the sixth month the fingers should have normal mobility, no contractures, and the grafts should have taken on the color and texture of the neighboring skin The splint may now be discarded during the day but is to be worn each night for another 4 to 6 months The soaks, exercises, and massage must be continued for at least one year after the operation

It must be emphasized again that a perfect immediate postoperative result will be completely

unsatisfactory unless the after care is efficient and continued for the length of time advocated This fact should be told the patient before operation and repeated at frequent intervals In every instance in this series where the graft has taken well without complications and when adequate postoperative care has been given, the result has been satisfactory both as to function and appearance In all other cases, whether the graft was good or not at first examination, when this postoperative routine has not been followed to the letter, the results have been unsatisfactory

#### CONCLUSIONS

From a study of 73 patients with congenital webbing of the fingers it has been found that the most satisfactory corrective operation combines the use of two flaps to form the commissure between the fingers and either a thick razor graft or a full thickness graft to cover the defects left on the fingers after separation It has also been found that splinting of these fingers combined with proper physical therapy and occupational therapy must be carried out for a prolonged period of time in order to produce a satisfactory result

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# THE PEDICLE TUBE-GRAFT IN THE SURGICAL TREATMENT OF HYPOSPADIAS IN THE MALE

With A New Method of Closing Small Urethral Fistulas

DAVID M. DAVIS, M.D. Philadelphia, Pennsylvania

**S**UCCESSFUL surgical treatment of hypospadias in the male depends entirely upon meticulous attention to a multitude of small details. Each contributor to the subject has added to our knowledge of these details. The technique is still far from standardized, but results are constantly growing better—at least in the hands of those willing to take the necessary pains. The object of plastic surgery is to create a condition as near as possible to the normal. In hypospadias, this means that the penis must be straight, the urethra large enough and of fairly uniform caliber and constructed from hairless skin, and the meatus in its normal place at the tip of the penis, so that both urino- and sexual functions can be performed properly. Plastic methods at our command now make this ideal quite possible and, indeed, not too difficult of attainment. It is better therefore, to abandon compromise methods the results of which fall short of the ideal, such as the creation of the new meatus in the frenal region.

It is scarcely necessary to say that the penis must be quite straight before plastic procedures are begun. At the time the congenital chordee is usually present, is eliminated surgically: a curved incision with one limb on each side of the meatus (Fig. 1 d, e) is very useful. It allows the urethra to be dissected free from the corpora cavernosa as far as may be necessary so that it can be dropped back and no longer contribute in any way to the maintenance of the chordee.

The Thiersch-Duplay method continues to be the foundation stone of the operative structure. It gives a hairless urethra of uniform caliber and there is no limit to the length of urethra which can be constructed. It is, however, difficult to carry a Thiersch-Duplay urethra fully to the end of the penis. For this reason, and in view of the recent increased interest among plastic surgeons in pedicled tube grafts, the author turned again to this old tried procedure.

A rectangular flap of skin was outlined (Fig. 2 d) on the dorsum of the penis and from this the tube was constructed. The pedicle was

produced at the proximal end of this flap, and at this end its edges were made to diverge, so that the new meatus would be sufficiently large and any tendency to contracture avoided. The sutures were interrupted and of the finest plain catgut, at first No. 000, later No. 0000.

It was soon found that with this arrangement the blood supply was much better than when the flap was left attached by its distal end. Consequently the tube graft could be made as long as the length of the penile skin allowed, without sloughing. The proximal attachment also allowed the penis to be bent over dorsally so that the entire length of the tube graft could be utilized. The procedure finally hit upon was to measure the length of the tube graft and then measure an equal distance upon the ventral surface of the penis, beginning at the tip of the glans. Over this distance a tunnel was produced by means of a sharp pointed bistoury and enlarged by means of a grooved director and scalpel to such a size that the tube graft could easily be drawn through it (Fig. 2 e). This enlargement was found to be very important, as without it stenoses were apt to develop in the new formed urethra at the meatus or elsewhere. Bleeding may be ignored as it stops at once after the tube graft is in place. The tube graft was fastened in place by four sutures joining its extremity to the adjacent skin and by three sutures at the new meatus, all of No. 0000 plain catgut. In some cases, a single additional suture of fine black silk was placed at the meatus. The penis was further held in this anteflexed position by a firm bandage which was not disturbed for at least 4 or 5 days. The tube was carried off by a catheter placed in the urethra through the already existing orifice.

The results of this procedure showed that the grafts survived perfectly in all of 6 cases. In 2 of the early cases, the pedicle sloughed, but in spite of this the tube graft obtained enough blood supply from the surrounding tissues to remain viable and the final result was excellent. Success in 6 consecutive cases is very significant, a fact which all perhaps be fully appreciated only by those who have attempted this type of surgery.

From the Department of Urology, Jefferson Medical College

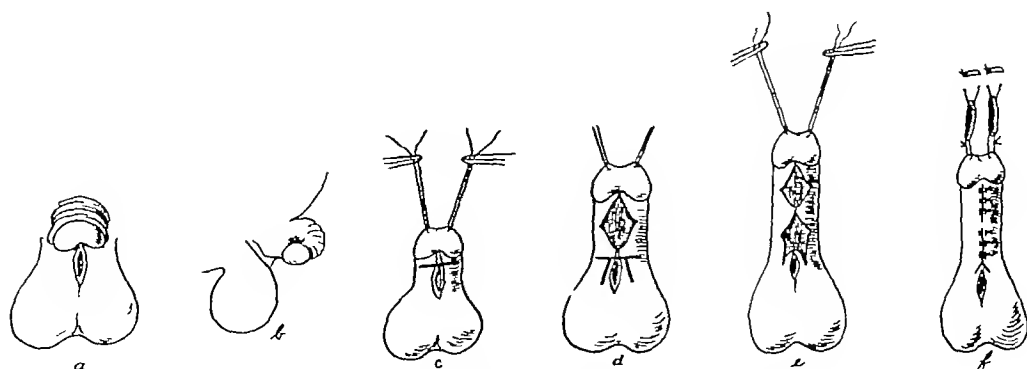


Fig 1 a, Extreme penoscrotal hypospadias (almost mid scrotal), congenital chordee, hooded prepuce b, Diagrammatic sagittal section, showing extreme curvature of penis c, Black silk traction sutures, transverse incision d, Second incision, with limbs to either side of meatus e, Penis straightened and lengthened, fibrous tissue removed, meatus pushed back f, Penis held in position by rubber bands sutured to abdominal wall, incisions closed longitudinally

After the lapse of 2 or 3 weeks, the pedicle is divided, leaving the meatus situated at the tip of the glans, in its normal and proper position (Fig 3, a, b) The scar left on the dorsum is apt to be puckered and unsightly at first, but within 6 to 12 months it practically disappears The end-result, generally, has been such that I have adopted the

pedicled tube-graft method as routine for the reconstruction of the glandular urethra When the technique described is used, the tube usually reaches from 1 to 2 centimeters proximal to the corona glandis on the ventral surface of the penis

The new glandular urethra may be joined to the original urethra by a Thiersch-Duplay plastic

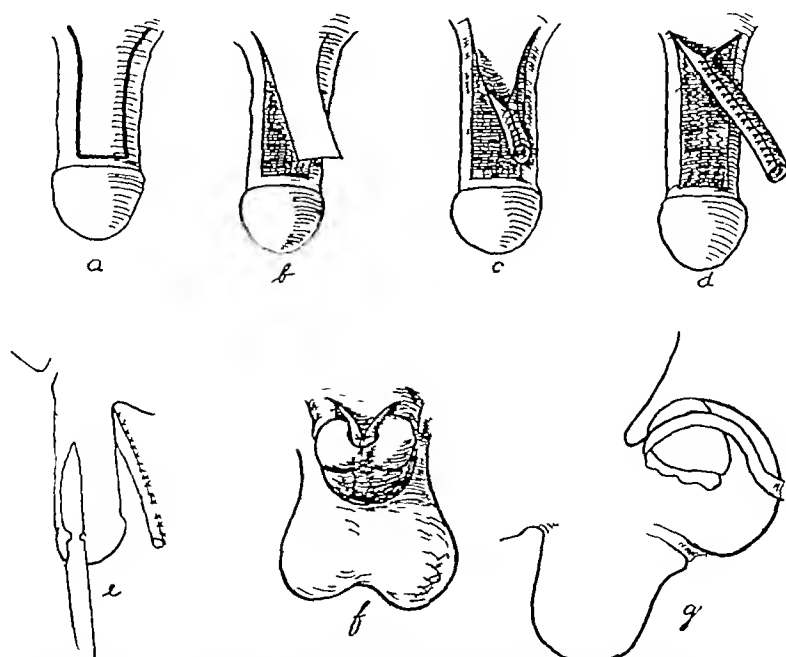


Fig 2 a, Line of incision for forming pedicle tube graft of preputial skin b to d, Construction of tube graft e, Opening of tunnel for tube graft f, Graft pulled through tunnel g, Diagrammatic sagittal section showing how penis is curved back to take advantage of full length of graft

# THE PEDICLE TUBE GRAFT IN THE SURGICAL TREATMENT OF HYPOSPADIAS IN THE MALE

## With A New Method of Closing Small Urethral Fistulas

DAVID M. DAVIS, M.D. Philadelphia, Pennsylvania

**S**UCCESSFUL surgical treatment of hypospadias in the male depends entirely upon meticulous attention to a multitude of small details. Each contributor to the subject has added to our knowledge of these details. The technique is still far from standardized but results are constantly growing better—at least in the hands of those willing to take the necessary pains. The object of plastic surgery is to create a condition as near as possible to the normal. In hypospadias this means that the penis must be straight, the urethra large enough and of fairly uniform caliber and constructed from hairless skin and the meatus in its normal place at the tip of the penis, so that both urinary and sexual functions can be performed properly. Plastic methods at our command now make this ideal quite possible and, indeed, not too difficult of attainment. It is better, therefore, to abandon compromise methods the results of which fall short of the ideal, such as the creation of the new meatus in the frenal region.

It is scarcely necessary to say that the penis must be quite straight before plastic procedures are begun. At the time the congenital chordee, usually present, is eliminated surgically a curved incision with one limb on each side of the meatus (Fig. d, e) is very useful. It allows the urethra to be dissected free from the corpora cavernosa as far as may be necessary so that it can be dropped back and no longer contribute in any way to the maintenance of the chordee.

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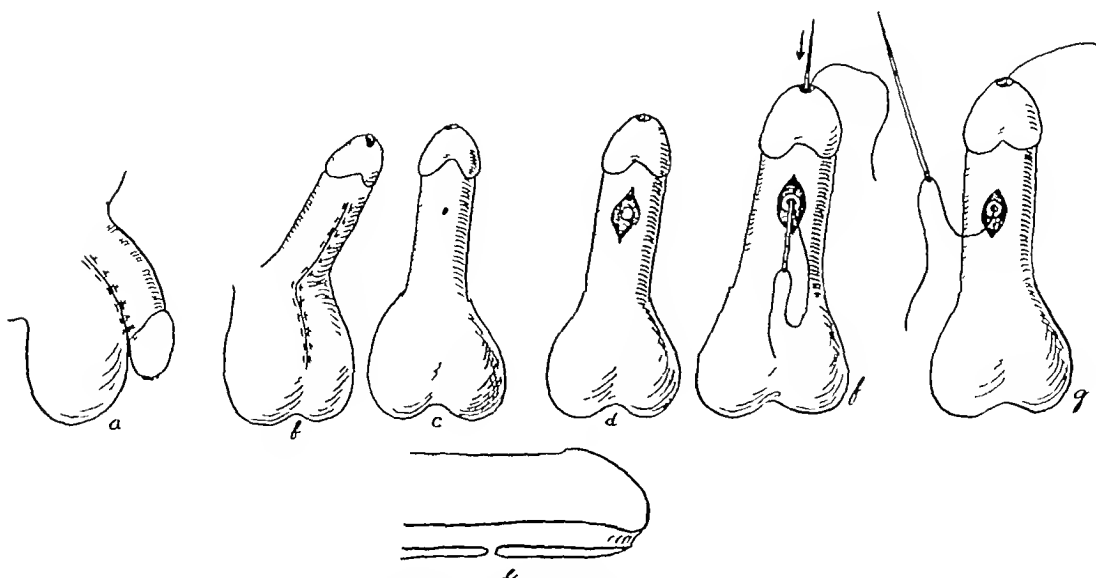


Fig 5 a, Penis sutured to scrotum, lateral view b, Penis cut free from scrotum after healing is complete c, Small fistula may remain after new urethra is constructed d, Fistula circumcised e, Diagrammatic sagittal section of fistula e to g, Needle with silk thread passed eye first through urethra and out fistula

record It is illustrated in Figures 6 and 7 and is characterized by two features First, after the fistula is circumcised and the skin undermined in the usual way, a straight needle armed with silk thread is inserted, eye first, in the new meatus, and brought out through the fistula The cut outer edges of the fistula are caught with the silk thread exactly as shown in the diagram (Fig 6, a, b) and the other end of the thread passed out again through the meatus The result is that when the two ends of the thread are pulled upon, the fistula is turned completely inside out, and made to project into the lumen of the urethra This inversion of the fistula is maintained by fastening the thread to the abdominal skin through the intermediary of a rubber band The silk thread pulls out in from 2 to 4 days, but by this time healing is almost complete The inversion may be further maintained by a purse string suture of No 0000 plain catgut, but this is not wholly necessary, as it has been omitted in one or two cases with no difference in the result The subcutaneous tissues are brought together by multiple sutures of No 0000 plain catgut While this is being done, an effort is made to pull one flap of skin or the other over the site of the fistula as far as possible

Since catgut in the skin is not conducive to good healing, practically all operators have used non-absorbable suture material for the skin Silk, cotton, linen, and fine silver wire have been rec-

ommended, and the sutures have been tied over rubber tubes, wires, and other supporting materials The most serious drawback applies equally to all non-absorbable sutures—in the presence of infection they act as setons and are very apt to produce the very pin-size fistulas one is so anxious to avoid My first effort to avoid this was the use of an epidermal running suture of very fine black silk This did not work well, probably because it closed the wound too tightly and permitted no drainage It then occurred to me to get around the difficulty by the simple device of using no skin sutures at all This plan has produced excellent results The subcuticular tissues are caught together by just enough very carefully placed sutures of No 0000 plain catgut to bring the skin edges into apposition (Fig 7) The 4 incisions so treated have all drained serum rather freely in the first 2 days, but have all healed *per primam* During the healing period the urine must of course be diverted, preferably by a perineal urethrostomy

A résumé of the histories of 3 completely cured cases follows

CASE 1 M M, aged 13 years was first seen July 7, 1936 Ritual circumcision had been done while patient was an infant Penoscrotal hypospadias with marked congenital chordee was present A good quantity of preputial skin was still present Testes were present in scrotum Urine was clear General physical examination was negative

Operation 1, July 10, 1936 Nitrous oxide and ether anesthesia was used Two transverse ventral incisions



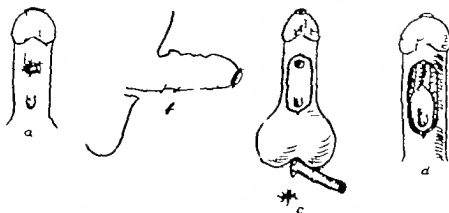


Fig. 3. a and b, The graft after division of pedicle. c and d, Incision and formation of new urethra by Thiersch-Duplay method, perineal urethrostomy established.

at the same operation or if there is any reason for delay the joining may be done later (Fig. 3, c, d.) The covering in of the Thiersch-Duplay plastic completing the new urethra has always been a difficult point in the procedure. If the penile skin is used, it must be brought together under a good deal of tension, and in addition the suture line in the skin lies directly or almost directly over the suture line in the new urethra, so that persistent fistulas are practically inevitable. This may be avoided by incision of the anterior surface of the scrotum (Fig. 4) and suture of the penis down to the scrotum. Hugh Cabot published a description of the procedure in 1936 and it properly bears his name although I utilized the same method exactly in 1 case in 1921 and in Case 2 of this series on November 14, 1935.

In most cases of penoscrotal hypospadias, this penoscrotal anastomosis is "very easy" but in mikrocrotal hypospadias with split scrotum, difficulty

may be encountered, and in perineal hypospadias it is of course not available as such. Fistula formation practically never occurs except at the distal extremity of the penile incision. At this point, a single pin-size fistula has occurred in every case in my series. I believe that this can be prevented in the future by the utilization of principles to be described in connection with method of closing these small fistulas.

When penis and scrotum are joined, they must of course be cut apart as soon as healing is complete usually in 3 or 4 weeks. It is a very simple procedure (Fig. 5, a, b). It may be done under local anesthesia, or may be combined with the closure of a small fistula, if there be one.

The small fistulas which frequently remain after construction of a new urethra constitute perhaps the most annoying and discouraging feature of hypospadias surgery. The method I have evolved for closing them has succeeded in every one of four consecutive occasions—a really sensational

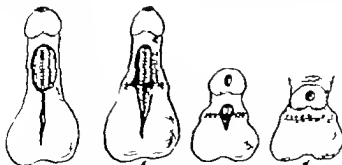


Fig. 4. a, Completed urethra, incision downward on scrotum. b to d, Penis sutured down to scrotum to cover new urethra.

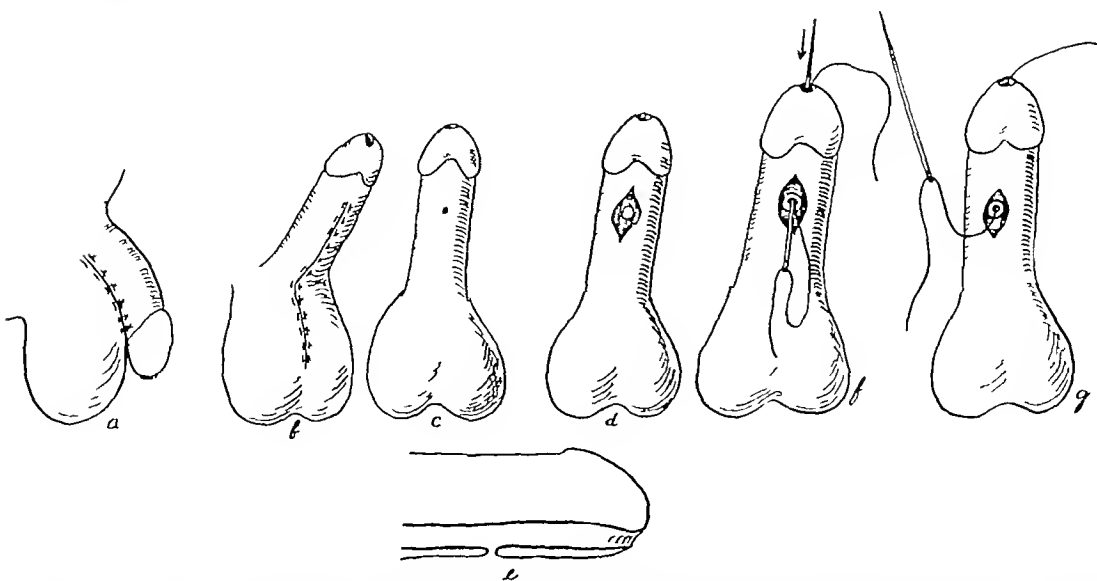


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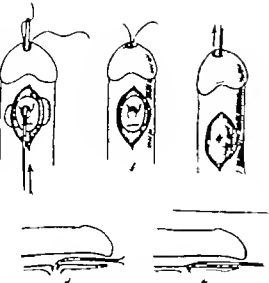


Fig. 6. a and b, Catgut catching edges of flaps as shown. c, Traction on threads in urethra, pulling it into urethra. d, Final result. e, Suture process shown in diagrammatic longitudinal section. Note that at site of fistula only raw surfaces are in apposition.

ere made adhesious. ere removed, penis was straightened, longitudinal closure as effected. Catheter as placed in the urethra for drainage. The incision healed. Patient as discharged July 8, 1936, with the penis sufficiently straightened.

Operation 4, August 3, 1936. Ether anesthesia as used. Perineal urethrostomy made and No. 10 catheter inserted. A tube graft as made from the preputial skin. A tunnel as formed in the penis and the tube dra through. The graft as very long and reached to the urethral opening. Each end as sutured to the skin as closed over this junction. The pedicle of the tube graft as divided 1 day later. The tube graft remained viable but the new meatus was too small. At the junction of the old and new urethra, the skin separated, a long ulcer about centimeter part. About 3 centimeters of new urethra remained.

Operation 5, December 25, 1936. Nitrous oxide and ether anesthesia as used. The perineal urethrostomy was re-opened. The meatus as incised and enlarged. The urethra as opened to the entrance of the penis. ere joined by a Deshay's plastic interrupted No. 10 catgut suture being used, the penile skin as sutured over this with silk mattress sutures. The incision separated no benefit as gained from this operation.

Operation 6, January 3, 1937. Nitrous oxide and ether anesthesia as used. Same operation as repeated. Continuous No. 10 catgut suture as used in plastic and non-furrowing skin closure. With epidermal suture of silk. The operation held except for small penile skin flaps. ere joined together. The meatus contracted again. On February 1937, the meatus as divided and a piece of rubber tubing inserted.

Operation 7, June 30, 1937. Nitrous oxide and ether anesthesia as used. A triangular flap of preputial skin

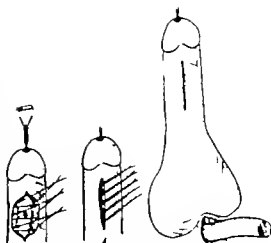


Fig. 7. a, Pomeroy suture about fistula, peri-urethral tissues dra together over it. b, Multiple buried sutures, all No. 10 catgut suture. Traction on inverted flaps maintained by fastening silk thread to bilateral silk elastic rubber band. c, Subcuticular suture dra together with multiple buried sutures of No. 10 catgut suture. Accurate placement of subcuticular sutures makes skin sutures unnecessary. Temporary penile urethrostomy established.

as sutured down. In the re-opened meatus. The small fistula as closed with one suture. The Pomeroy suture and the skin as closed with catgut suture. A catheter re-inserted in the perineal urethrostomy. The meatus healed and remained open. One pie-point fistula persisted.

Operation 8, August 5, 1937. Nitrous oxide and ether anesthesia as used. The small fistula again inverted with suture. The catheter as re-inserted in the perineal urethrostomy. This operation as successful.

Operation 9, December 20, 1937. Same operation repeated. This operation as successful.

Operation 10, July 5, 1938. Nitrous oxide and ether anesthesia as used. At this operation, for the first time the fistula as everted by silk threads as in Figure 6 and the entire closure made by single plain catgut sutures. One and subcuticular sutures, as in Figure 7. Primary union occurred. After the many operations the perineal urethrostomy had become epithelialized and did not heal.

Operation 11, August 1938. Nitrous oxide and ether anesthesia as used. The perineal fistula as everted, and No. 8 rubber catheter left in the urethra. The perineal ulcer closed almost per primam by small portion of the floor of the penile urethra sloughed out, apparently due to pressure from the retention catheter and left another good sized fistula (5 mm in diameter). This urethra, previously dysfunctional, after complete success had been obtained.

Operation 12, December 1938. Nitrous oxide and ether anesthesia as used. Perineal urethrostomy as made. The penile fistula as again closed by the silk buried eversion technique (Figs. 6 and 7). Healing occurred per primam. The perineal catheter removed on the seventh day. Patient discharged from the hospital 8 days after operation. The perineal fistula closed spontaneously a few days later. The new urethra



along the midline of the scrotum, and the scrotum and penis were sutured together to cover the new urethra. Sulphanilamide was given after operation. Excellent healing occurred. The pedicle of the tube graft was not divided until the eighteenth day. On July 19, 1930, the new urethra was intact except for one very small pin-point fistula at the point where the per of the scrotal incision was joined to the penis. The urethra resisted dilatation, so it was enlarged with the Otis internal urethrotome. After this the patient voided with large strong streams.

Operation 4, September 3, 1930. Spinal anesthesia was used. The urethra was dilated to No. 30 French. A perineal urethrostomy was made. The fistula was closed by the silk thread eversion technique (Figs. 6 and 7). The scrotum and penis were cut apart, and wound closure was accomplished by subcutaneous and subcuticular sutures of No. 000 plain catgut. It is an skin wet res. Sulphanilamide was given after operation.

The fistula remained closed. The urethra has been dilated from time to time. It is now pliable and elastic and admits No. 30 sound easily (Figs. 8 and 9).

This case is interesting as an example of the fact that good healing of penile plastic operations cannot be obtained unless the urine is uninfected. After clear and sterile urine was obtained the entire plastic construction of the new urethra was successfully completed in two operations in a period of 4 months.

The methods here described have been or will be used in 6 other cases which are in various stages of treatment. They have been very beneficial and have added a new note of confidence to the operative plans and procedures. The surgery of hypospadias is a fascinating field for those willing to devote the time and effort necessary to become competent in it, but it should not be attempted by others, as neither surgeon nor patient is likely to benefit.

# A METHOD FOR THE PREVENTION OF SPREAD OF OSTEOMYELITIS OF THE BONES OF THE SKULL

WILLIAM P. VAN WAGENEN, M.D., Rochester, New York

THERE has long been a need for some means by which infection within the diploe of the bones of the skull might be limited in its spread. The sutures offer some resistance but the infected bone cannot be unlocked from the normal bone without breaking down this barrier. A method which has proved satisfactory in the handling of osteomyelitis of the bones of the skull and also a method of protecting the edges of bone about a draining brain abscess consists of turning a flap of viable periosteum over the cut edge of bone, tucking it between the dura and the inner table of the skull. This may be done in one or two stages. In the case of infection of the frontal bones an incision in the scalp is made from one temporal region to the other approximately 2.5 centimeters posterior to the coronal suture. A good deal of care is exercised in incising the scalp and galea that the underlying periosteum be left intact. The scalp flap is reflected forward for about 3 to 4 centimeters. The periosteum is then incised in a line from one temporal muscle region to the other, the line of incision being at, or just posterior to, the suture line. A series of burr holes posterior to the coronal suture are made and a channel of bone approximately 1 centimeter wide is removed. The periosteum is then tucked between the dura and the inner table of the skull and the scalp closed with interrupted sutures of No. 000 plain catgut.

At the second stage, assuming that the patient's condition warrants waiting until another stage, the scalp flap is reflected forward until the region of the frontal sinus is well exposed. Assuming that the periosteum over the periphery of the frontal bones does not appear to be infected, it is dealt with in the same manner as described and as illustrated in the accompanying drawings, Figures 1 to 7. However, if there is any question of infection of the outer table of the skull at a point where the periosteum should be incised for this maneuver, the temporal muscle is separated from the bone and the edge of this turned in between the dura and the temporal bone below the temporofrontal suture line.

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University of Rochester School of Medicine and Dentistry.

After the edge of bone has been completely covered with periosteum the infected portion is removed, usually in one piece. Bleeding points from the dura are secured either by use of the endotherm or with muscle implants.

It is thought quite essential that bone wax should not be used in stopping bleeding from points in the diploe. The careful use of rongeurs in scraping bone over bleeding points will ordinarily suffice to take care of any such hemostasis. The scalp is then reclosed with adequate drains. The removed bone flap is boiled and preserved for future use if a plate is thought necessary.

CASE 1. Hospital No. 131,559, G. E., aged 32 years, was admitted to the hospital September 1, 1937, with a complaint of paralysis of the right side of the body for a 2 month period and inability to speak for 4 days.

This 32 year old man considered himself well as usual until about 4 years ago when he developed an osteomyelitis of the right tibia which was surgically drained. Six months following this he developed an abscess in the right buttock which drained spontaneously and healed. Shortly after this he developed an abscess in the region of the right lower femur and was found to have an osteomyelitis of that bone. This was drained but has continued to discharge pus intermittently for the past 3 years.

During the past year the patient has gone downhill physically and has been too feeble to carry on with his work as a farmer. His wife gives a history of recent faulty memory and of some difficulty in motor of speech. During the past few weeks he complained of daily bi-frontal headaches. Two months ago he complained of sharp pain and tenderness and swelling over the vertex of the skull. Roentgenograms revealed changes in the bones of the skull near the frontoparietal junction. The scalp was incised in this area and "the bone scraped". The right arm and leg soon became weak and finally paralyzed. One week following the first operation a second one was performed at which time further bone was removed and an extradural abscess was also drained. During this hospitalization he was said to have had three generalized convulsions. Further details of these are not available. Vomiting has been persistent for the 2 weeks prior to admission. All motor speech has been in abeyance for some 4 days prior to admission.

Physical examination showed an extremely ill appearing man who was conscious but unable to speak. He was dehydrated, the breath was foul, the tongue coated. There are several areas along the incision in the scalp which are about to break down and discharge pus. There was a discharging sinus over the right lower femur. The patient was found to have a low grade fever, a leucocytosis of 13,000, and a moderate secondary anemia. Roentgenograms of the skull showed a large area of destruction involving both the outer and the inner tables of the calvaria immediately in front of the bregma. The pineal gland was densely calcified and was displaced grossly to the right of

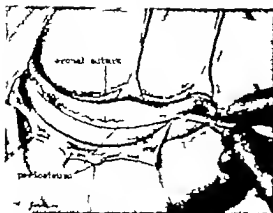


Fig. 2. Drawing to illustrate scalp incision from one temporal region to the other posterior to coronal suture. Periosteum is incised at, or just behind, suture line.

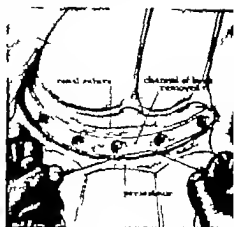


Fig. 3. Channel of bone being removed posterior to coronal suture.

the midline and also back and downward. Recent photographs of the femur showed typical appearance of long standing chronic osteomyelitis at the lower end of the shaft. It was soft tissue reaction and destruction about it.

On September 3, 1937 under novocain and ether anesthesia semicircular incision was made from one temporal region to the other keeping 10 mm. back of the coronal suture. There was evidence of extensive chronic osteomyelitis of the frontal bones extending up to the coronal suture. The infected bone was kindly removed after burr holes were made in it. It appeared normal parietal bones and the periosteum was turned in between the table of the normal bone and the dura as described. Little bleeding of consequence from the longitudinal sinus was encountered in this procedure. The dura was found to be covered with

granulations. Through an area of dura that had sterilized one needle tap was made into the right table but no evidence of an abscess as yet. The dura of the suspected left frontal abscess was then opened, a

defect approximately 3 centimeters in diameter. Abscess was encountered with an exploring needle depth of 4 to 5 centimeters. A core of brain down all of abscess was removed with the endosteum, so cut in the abscess wall and soft rubber tissue was lowered. The scalp was then replaced brought drains out through the stab wounds. The scalp was left in place.

Bacteriological examination of pus obtained from abscess at the time of operation showed the organisms both on culture and smear the *Staphylococcus aureus*.

The patient made surprisingly good recovery and discharged from the hospital 10 days after admission. The scalp wounds closed. The discharge from the left continued. Because of the chronic infection of the left the patient as advised to have the leg amputated as done several weeks after discharge from the hospital.

The patient as last heard from in February of 1938 had made good recovery of several epileptic seizures but is otherwise well. There has been no further extension of the osteomyelitis of the skull.

CASE. Hospital N. 6, 505 F. L. R. aged 47 years admitted to the hospital January 20, 1930, because of discharging sinus near the midline of the skull in the frontal region.

The patient, railroad clerk, had been a Texas for the past 20 years and he had come himself off of some 9 months ago he accidentally bumped the frontal region of skull on piece of coal. The skull was not broken and he was not rendered unconscious. He has since had headache the time of the day and thought that he was slightly drunk. 10 days later he experienced sudden change in vision which almost lost him blindness. From his description it was as though he had lost most of the vision. With the exception of some central vision gradually returned to normal. He also complained of headache and mild degree of vertigo at time of this episode.

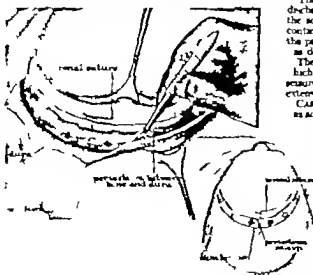


Fig. 4. Periosteum being pulled between dura and inner table of parietal bone.

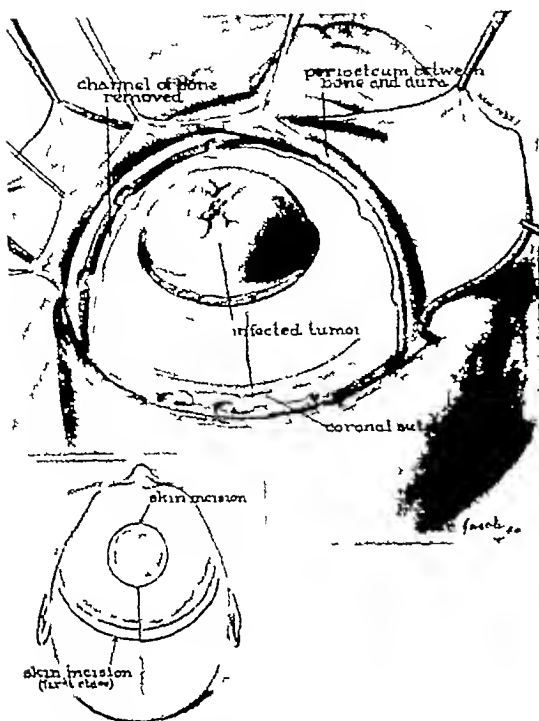


Fig 4. Periosteum being tucked between dura and inner table of frontal bone or temporal bone

At about the time of the onset of visual disturbances he noticed the appearance of a lump at the site of injury, which continued to increase in size. It was non tender, of

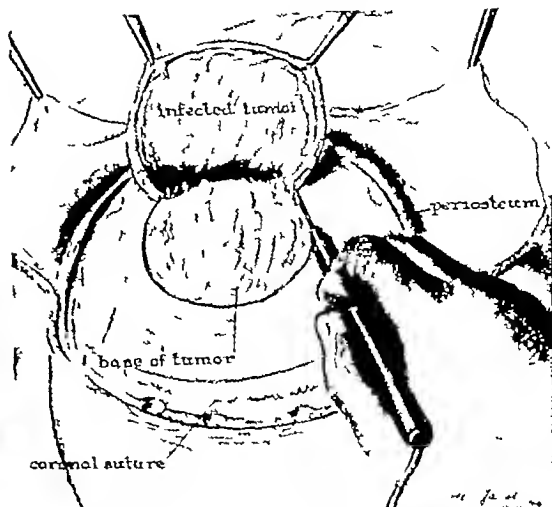


Fig 5. Infected tumor being removed with endotherm to facilitate elevation of bone flap

normal skin color, and it was only because of its size that he consulted a physician some 7 months ago. It was thought that there was evidence of an osteomyelitis of the skull. Sulfanilamide, dosage unknown, was prescribed for a period of approximately 1 week without effect upon the size of the swelling.

Six months ago an operation was performed at which time an area of bone approximately 4 centimeters in diameter was removed just to the left of the midline in the midfrontal region. The wound failed to heal properly and has continued to discharge pus intermittently since that date. The tissue removed is not available for section and a report on its nature cannot be obtained. Shortly after the

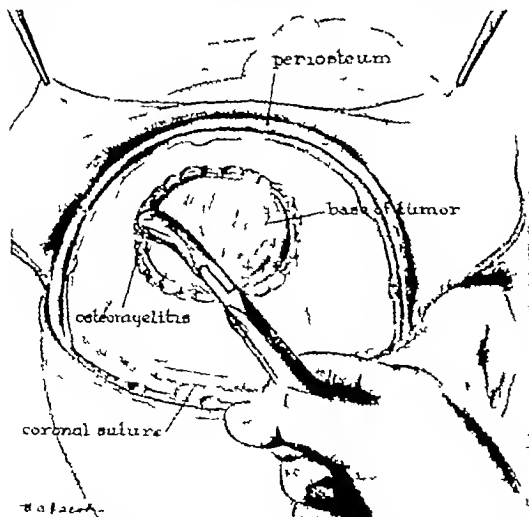


Fig 6. Infected bone being freed from attachment to underlying dura prior to elevation of bone flap

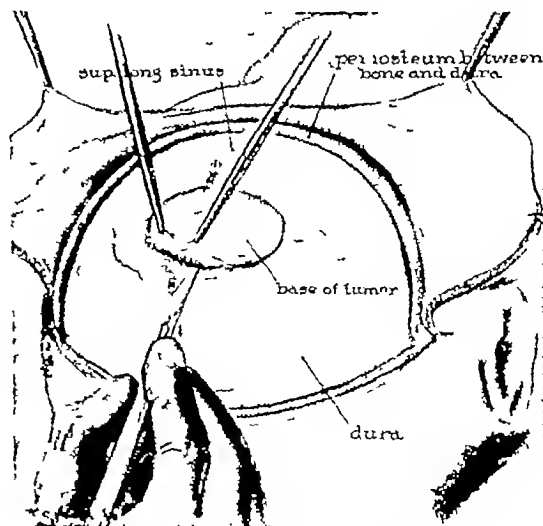


Fig 7. Base of infected tumor being dissected free from dura





Fig. 8a



Fig. 8b



Fig. 9

Fig. 8. Photograph taken before operation showing side and front view of infected tumor of scalp and skull.

Fig. 9. Photograph taken at time of patient's discharge showing area of skin graft.

bone described had been removed the mass began to reappear and has increased in size up until the present time. About a month ago several pustular areas about the peak of the mass developed. One month ago he was given course of potassium iodide and bismuth. These effect except to increase the amount of discharge. Pain at the site of the tumor has been negligible. Regional lymph nodes have not been enlarged as far as he is aware. Headache has been minimal symptom. He has not had other symptoms of increased intracranial pressure such as vomiting. There has not been symptoms referable to either frontal lobe.

The patient, as thought to have, an attack of influenza some 3 months prior to entry at which time had considerable cough and low grade fever.

The past history is irrelevant.

Physical examination showed relatively small, gray, but well developed mass, no evidence of slight loss of weight. The skin had rather yellowish tint. The frontal region was mass protruding from the level of the skull which measured approximately 4 centimeters in diameter and 3 to 4 centimeters high. There was discharging crater area at vertex. The mass was stony hard and nontender. The cervical regional lymph nodes were not enlarged. The rest of the physical examination, as usually separate both from the general point of view except for few lesions over each bone. The findings on neurological examination were normal.

**Laboratory findings.** Washings of the pus obtained from the wound were studied by Dr. Milton T. Jor and Dr. Kurt at Chilton Springs. *Haematuria*. Organisms suggests of *Coccidioides immitis* are observed. Some of this material as injected into three guinea pigs all of which died in about 8 days. The last blood count was 3,900, red blood count, 3,600,000, hemoglobin 9 grams. Sincor showed polymorphonuclears, 75 per cent; lymphocytes, 3 per cent; monocytes, 8 per cent; eosinophils, 6 per cent. Urine was negative. Roentgenograms of the skull were made. The anteroposterior and lateral exposures show large defect in the left frontal bone which is quite sharply outlined with large soft tissue shadow above it. The pitted body which is densely calcified, does not appear to be dis-

placed. Roentgenograms of the chest show the outline of the heart to be normal. The left pulmonary root shadow is large and appears nodular. The right pulmonary root shadow is normal. Below the right root is an area of infiltration, soft in character. The remaining lung fields are clear.

On the basis of these observations diagnosis of coccidioidal granuloma with secondary pyogenic infection involving the pulmonary tree and the right frontal bones of the skull and scalp is made.

After the literature on Coccidioides immitis as reviewed and the reports noted of the relative benign course of most of the cases of pulmonary infection and the 50 per cent mortality of cases in which the infection involved the bones, it was decided to remove the granuloma of the skull. On February 1, 1940, under novocain anesthesia an incision was made from one temporal region to the other. The periosteum was raised and debrided. It is described per loosely. The wound healed by primary intention.

On February 1, 1940, cranioclogram as made took showed very slight depression of the anterior horn of the left ventricle but did not give other evidence of intracranial extension of the frontal process. The same day under avertin, 70 milligrams per kilogram of body weight, and novocain anesthesia, the scalp was reflected forward until the region of the frontal sinuses could be exposed. A tunnel of bone similar to the one described, as then made about the periphery of the frontal bone. It was found advantageous to remove the bulk of the soft tissue mass like the endosteum before the bone flap was reflected. Very little bleeding of consequence occurred from the longitudinal sinus. When the bone had been levated, the remaining base of the mass was then removed by sharp dissection from the dura and the overlying longitudinal sinus. The wound was again closed with interrupted sutures of triple plain catgut. Anchloramide packs were left over the dura. Here the skin and overlying bone had been removed. The defect in the dura was skin grafted by Dr. Forest Young before patient was discharged from the hospital.

Pathological examination of the soft tissue removed showed that the greater portion of it was an adenocarcinoma, source undetermined, but presumably from

bronchus. Bacteriological examination of the pus removed at this time failed to give evidence of a *Coccidioides immitis*. An *Aspergillus mucuroides* was recovered, however, together with the *Staphylococcus aureus*. The bone about the mass was definitely infected presumably by the *Staphylococcus aureus*.

Re-examination of the skull by x ray at the time of discharge from the hospital failed to give any evidence of any extension of infection into the parietal bones.

Final diagnosis (1) Adenocarcinoma of lung? (2) Adenocarcinoma, metastatic, frontal bones and dura. (3) Secondary infection of tumor mass with *Coccidioides immitis* and *Aspergillus mucuroides*. (4) Secondary infection of tumor and frontal bones with *Staphylococcus aureus*.

#### SUMMARY

In the presence of osteomyelitis of the bones of the skull either from an adjoining frontal sinus in-

fection or from a metastatic source, it is felt that a radical excision of bone is indicated after chemotherapy has been given a fair trial. The edges of normal bone may be protected from infection by the use of a flap of periosteum which is tucked between the dura and the inner table of the normal bone.

It is our opinion that bone wax should not be used in arresting hemorrhage from diploe which may be subject to infection. The judicious use of rongeurs will arrest any ordinary diploic bleeding. It is also advantageous to protect the normal bone edges with viable periosteum about the site of a draining brain abscess before the dura is opened and the abscess is drained.

## THE RECURRENT INGUINAL HERNIA

### The Importance of an Artificial Fibroplastic Proliferative Phase in Hernia Repair

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THE recurrent inguinal hernia continues to be a problem to the surgeon and an economic handicap to the patient. There is probably no common operative procedure in which good results are more dependent upon the skill and the experience of the surgeon and the technique which he employs. When we compare the progress which has been made since the time of Bassini, 50 years ago we can appreciate the great advances which have been made in the reduction of recurrences. The frequent reports of recurring hernias today clearly indicate that the problem is still far from being solved.

True recurrences are relatively uncommon if we limit the term to the return of the exact type of hernia which previously existed. A hernia is usually considered to be recurrent when it occurs in the same region in which it was formerly.

The successful repair of a hernia is a joint contribution of the surgeon and the patient. The surgeon's part is to select the proper type of operation suited to that individual case and to do the operation in a skillful manner. The contribution of the patient is not only his co-operation during the postoperative period, but also his inherent ability toward wound healing. This fundamental wound repair unfortunately is beyond the patient's conscious acts or wishes, and until recent years the surgeon has not been able to alter this phase to any degree.

As we study the problem of hernia, it is evident that while many factors enter into a successful repair two factors are very essential for success: first, the operation must be properly performed with suture material which must be capable of holding the tissues in the position sutured for a period of time long enough for firm union to occur; second, the amount of union and the strength of the union of the sutured tissues must be increased so that the result will be permanent.

During the past 9 years 603 operations for inguinal hernia were performed. Among this number 65 or 6.1 per cent, were recurrent inguinal hernias. These recurrent hernias were usually associated with an atrophied, weakened stretched out or poorly developed internal oblique

muscle and fascia or a weakened partially destroyed Poupart's ligament. Factors responsible may be injury from previous operative repair too tight suturing, and postoperative infection with or without sloughing of the tissue in the line of suture.

The age at the time of recurrence was 20 to 30 years, 14 per cent, 30 to 40, 33 per cent, 40 to 50, 36 per cent, 50 to 60, 15 per cent, 60 to 70, 1 per cent, and above 70 years, 1 patient.

In this group of patients it is noted that more than half were in those past the age of 40 years. This might suggest that the weakened condition of the musculature of the inguinal region was a part of the general muscular weakness seen not infrequently in people past 40, particularly in those who exercise little and eat too well. It is also seen in those whose general health is poor and in those who show signs of malnutrition. The signs are very common in the laboring classes.

The causes of recurrence may in general be divided into two groups: first, factors relating to the patient—age, muscular development, degree of obesity or of malnutrition together with the type and size of the hernia present, and to this must be added the ability of patient to produce fibrous tissue for sound wound repair; second, the surgeon's responsibility—sepsis may have resulted from carelessness, hemostasis may not have been complete or ligatures have been carelessly tied, the hernia sac may have been improperly ligated or sutured, the suture material may have been poorly chosen, nerves may have been injured, the sutures may have been tied so tightly that the tissues were strangulated, all available tissue may not have been used or the operation may not have been entirely suited to the type of hernia present. Good wound repair can follow only delicate manipulation of tissues in the operative field, and the leaving behind of irritating foreign material in a minimal amount.

Of the 165 recurrent hernias, 16 per cent were my own cases which had been repaired formerly by a modified Bassini technique and the use of catgut or silk as the suture material. Six per cent had been operated upon outside the United

States In 4 per cent the records did not state where the original operation was done The 74 per cent remaining had been done by various operators in different parts of the United States

In 1 patient so far as could be determined, the external ring only had been sutured In 8 patients apparently nothing had been done except ligation of the hernia sac The Ferguson method had been used in 6 patients The Bassini method or its modification had been used in the remainder Except in 11 instances the suture material used had been absorbable In 10 silk or linen sutures were found incompletely holding the conjoined tendon to Poupart's ligament Silver wire had been used in 1 patient

Hernias which have been previously repaired more than one time usually offer greater difficulties for subsequent repair without the use of fascial transplants or special technique for building up a stronger inguinal region Those that have recurred three or four times certainly indicate the need of a very careful pre-operative study as to the cause, a well planned fascial transplant and a carefully followed postoperative supervision, with an occasional recommendation that the patient be not again assigned to heavy manual labor Of these 165 recurrent hernias, 77 per cent had been repaired once previously, 13 per cent two times, 7 per cent three times, and 3 per cent had been operated upon four times previously

The obese patient offers a problem The operation is not only more difficult and prolonged, but the increased preperitoneal fat is a problem in suturing the muscle and fascia layers in satisfactory apposition The sutures are difficult to tie and when they are tied the surgeon cannot help but wonder if the slick greasy knots will really hold

Increased intra-abdominal pressure should not be underestimated as a factor in the recurrence of a small percentage of hernias The reintroduction of a large amount of omentum and intestines which have been resident outside the normal peritoneal cavity may definitely increase the postoperative intra-abdominal pressure It is possible that the relatively large amount of air that remains in the abdomen of the well relaxed patient under spinal anesthesia may be a temporary minor factor in increased intra-abdominal pressure Postoperative distention, vomiting, cough, and even restlessness give marked increases in the stress and strain of the operative area These acts may tear the peritoneal suture line or disrupt the suture material, especially if catgut, and once an entering wedge is permitted, a later recurrence is probable By thoughtful postoperative manage-

ment of the patient, abdominal distention, vomiting, cough, and restlessness may be largely eliminated, and these factors removed as a cause of later recurrence

In the older male patients and in those with repeated recurrence of hernia who must engage in manual labor, division of the spermatic cord structures and in some cases, orchidectomy when the patient will give his consent, are indicated Necrosis of the testicle does not occur as the result of cutting the cord structures unless the testes have been disturbed from their normal attachments in the scrotum In massive hernia the testicle will be disturbed, and permission should be obtained if possible to remove it Necrosis of the testicle requires a later operation for its removal or drainage

The experimental and clinical data of the past few years are of great interest and of definite importance to the surgeon who feels the urge to reduce his percentage of recurrences This is particularly true of the data relating to suture material Catgut is made from the submucosa of sheep intestine, a protein substance, a collagen with hygroscopic properties which, when brought into contact with body fluids, absorbs them rapidly, softens, and swells There is no test that will determine its duration of proper function In reports on evisceration numerous authors have mentioned complete digestion of the catgut used by the third to the fifth postoperative day Bowen states "Since catgut is rapidly digested in the presence of infection the tensile strength and continuity of a continuous suture in contact with a draining wound would be destroyed long before adequate healing has occurred in the rest of the wound" In patients allergic to catgut a similar disintegration results prematurely as in the presence of infection

Infection, trauma, and blood clots in the suture line retard the onset of the normal phase of fibroplasia rather than inhibit growth of fibroblasts Catgut in large quantities, or in sizes larger than necessary, produces a marked exudative reaction which retards fibroplasia, and wound healing is delayed In wounds other than hernia in which no stress is thrown on the suture line, Ogilvie has shown that in normal healing from the fifth postoperative day onward, fibroblasts are laid down rapidly so that by the tenth day the sutured tissues have a tensile strength approaching 90 per cent of normal But the hernia repair is often not a comparable procedure The tissues are sutured under more or less tension The tension in some cases is so great that the sutures cut through or necrosis of tissue occurs This not

only delays fibroplasia but especially if absorbable sutures have been used separation of the muscle and fascia will have occurred—which is the first step in the recurrence of the hernia. The size of the catgut used has a bearing upon the tissue reaction. Sutures of greater tensile strength than the sutured tissue itself should be unnecessary. It has been shown by Harvey and others that No. 1 and No. 2 chromic catgut is approximately ten times stronger than the holding power of fascia. It would seem unnecessary to use catgut of larger sizes, for since it is not required for strength it will only cause more protein reaction, exudative reaction, which would delay wound healing.

It has been repeatedly demonstrated that catgut produces a marked local reaction and that tissue union is delayed particularly about plain catgut. About plain catgut an extensive tissue reaction occurs. The large zone of round cell infiltration prevents or markedly retards fibroblast proliferation. Bower, Burns, and Menzies have shown that there is far less tissue reaction about chromic catgut, and that fibroblasts may be found within 4 days starting to unite the structures together. If catgut is the suture material decided upon it should be fine chromic to insure less tissue reaction and earlier healing. The larger sizes of catgut do not last longer than smaller sizes, for the digestive enzymes digest the inner fibers of the twisted catgut strands as rapidly as the outer strands.

Jenkins in experiments on catgut sutures in tissue fluids finds that plain catgut lasts 5 to 6 days by tension suture tests. Chromic catgut maintains its tensile strength much longer without regard to the size of the catgut used. There is no advantage in using heavy catgut and there are many disadvantages.

Meade and Ochauer have shown that fine twisted cotton thread is useful as a suture material and in some respects seems more suitable than silk. Parsons has reported that with the use of linen the number of infections was increased and the results more nearly approximated that following the use of catgut sutures. Torek believes that he gets a firmer union and less danger of infection by using silver wire for the lowest two sutures holding the conjoined tendon to Poupart's ligament. Babcock and others favor annealed rustless steel sutures.

Absorbable sutures should not be used where there is undue tension. The same may be said for fascial sutures or for transplanted flaps of fascia. If there is tension the pull should be upon non-absorbable sutures and the fascial sutures or the

flap of fascia may be inserted into place without tension.

Burdick and his associates have shown that when fascial sutures were used the percentage of primary infection of the wound was higher. Any procedure which complicates an otherwise simple process and prolongs the operative period will invariably be followed by a higher infection rate. In the presence of infection healing of the tissue does not occur early and separation of the suture lines predisposes to a recurrence of the hernia. Burdick also noted that, in recurrent hernias in which fascia had been used previously at the time of the later operation slight evidence of the fascia lata sutures could be found. He further observed that when ox fascia was used instead of autogenous fascia, the number of recurrences was increased by 8 per cent. Burdick and his associates have reached the conclusion that they will cease to use fascia routinely but have adopted silk sutures as a routine procedure. This was done in the belief that they could give the patient a better chance of a permanent cure with silk than with fascia.

Fascia will occasionally be definitely required. The most difficult recurrent hernia to repair is one which is very infrequently seen, in which there has been a previous destruction of Poupart's ligament. This may result from infection together with too tight suturing at the time of a former repair. Such a finding requires the reconstruction of Poupart's ligament by some plastic method. As previously reported this may satisfactorily be accomplished by a pedicled flap composed of the tensor fascia lata muscle and its continuation of fascia lata. After the pedicled flap has been sutured with silk to reconstruct Poupart's ligament, the operation may then be completed with the usual hernioplasty technique. The use of living sutures or fascial transplants may well be reserved for the occasional selective case, but one should not hesitate to use it when additional fascia is clearly indicated.

While the choice of suture material is important, many recurrences will take place irrespective of the suture material chosen. Parsons has shown, however, that his recurrences were almost four times as frequent when catgut was used as when silk was used. In a series of 200 cases reported by Fallis, 96 per cent had previously been sutured by silk. When all types of suture material from the experimental and clinical aspect are considered, it is evident that hernias will recur. While the percentage of recurrences will be lessened by the use of non-absorbable material, recurrences cannot be prevented. If further

reduction in hernia recurrence is to be expected, some means must be used whereby an added stimulus to fibroplasia is produced, with the result that firmer union of the sutured tissues is brought about.

The injection method of treatment of inguinal hernia has given rise to considerable controversy among the medical profession as to its value. Whatever may be the attitude of the average surgeon today regarding that method, the experimental laboratory has demonstrated one principle of importance which even the most critical surgeon must acknowledge. The introduction of fluid irritants properly chosen will stimulate the production of fibroblasts and by this overstimulation a firmer union will result. Sixty years ago Billroth stated that if anyone could find a solution that would produce artificial proliferation of tissue the problem of radical treatment of hernia would be solved. Rice, Stoner, Fowler, Manoil, and others have written of the experimental results following the injection of irritant fluids. In animal experiments using different solutions Manoil found that with the use of tannic acid solutions, "the inflammatory exudation was mild, reaching its peak at twenty-four hours and then subsiding completely in the next forty-eight hours. Proliferation of fibroblasts became predominant in three days and at seven days there was some evidence of new collagenous tissue with dense fibrous tissue at eight weeks." The injection of different solutions, such as sodium psyllate (syal-sol), produces almost identical results with slightly less local reaction. When solutions are used which do not produce necrosis, at the end of 14 days sections of tissue show a great amount of fibroblastic reaction adjacent to muscle tissue and extending down between the muscle bundles. Sections at 8 weeks show that adult fibrous tissue has replaced the fibroblasts and that it holds the adjacent tissue firmly adherent to the adjoining muscle by extending between the muscle bundles—a permanent union. The injection of irritant fluids properly chosen results in the extensive proliferation of fibroblasts, and collections of fibrous tissue may be made to form wherever it is desired.

By the term "irritant fluids properly chosen," I mean those fluids which when injected into the tissues produce no necrosis, no tissue destruction, but do produce a stimulation of fibroblasts from the normal fibrous tissue present in the inguinal region. A fluid which produces necrosis has no place either in the injection method alone, or when used as a part of an operative hernia repair.

Apparently in many well sutured, well performed hernia operations, not sufficient fibrous tissue is formed to hold the tissues in the position in which they were properly sutured. Consequently there is a separation of the internal oblique and transversalis muscle and fascia from Poupart's ligament, and the hernia recurs. Individual reaction to the production of fibrous tissue as the result of trauma is demonstrated frequently. Some skin incisions heal with a white line which is scarcely visible after a short time. Another patient with the same stimulus will produce a piling up of scar tissue which we call keloid. All degrees of fibroplastic proliferation are seen between these two extremes, resulting from identical stimuli. It is evident that the deeper tissues react very similarly as does the skin in forming scar tissue as the result of an identical stimulus. This individual reaction to the same stimulus is very apparent in the injection treatment of hernia. The same solution in identical amounts will produce such varying results that, to obtain the same result, many patients require twice the number of injections as do other patients.

With the realization of the need of the stimulation of fibroplastic proliferation in the usual operative repair, and the ease of production of more fibrous tissue by the injection of irritant fluids, the injection method has been made a part of the operative repair of recurrent hernias. During the repair of inguinal hernia, injections are made along and beneath the suture lines. After the hernia sac has been ligatured or sutured and the transversalis fascia has strengthened Hesselbach's triangle as well as is possible with sutures, the conjoined tendon is sutured to Poupart's ligament by interrupted sutures of fine silk. Five cubic centimeters of a tannic acid solution is then injected beneath the suture line. If the sutures have been properly placed there will be no escape of this fluid. It will spread out medially as far as the dissection has separated the muscle and fascia planes, and will extend along Poupart's ligament and the suture line in that area. After the retracted cord structures are replaced, if the cord is to be placed below the aponeurosis of the external oblique muscle, the aponeurosis is sutured to Poupart's ligament with fine silk interrupted sutures. The external ring is made as tight as will permit without undue constriction of the cord structures. A second 5 cubic centimeters of tannic acid solution is now injected below the sutured aponeurosis, which spreads out along the suture line and between the conjoined tendon below and the aponeurosis above. Usually, a small amount will find its way through the external inguinal

ring. This is not sponged away but is allowed to remain, and the superficial fascia and fat are sutured with silk so that no spaces between tissue will remain. The skin is closed with dermal or skin clips. Injections 2 weeks later up inside the external ring before the patient leaves the hospital and again in 30 days will give an added stimulus to the production of fibrous tissue, sufficient it is hoped to hold the inguinal structures permanently in the position in which they were properly sutured. Aqueous-alcoholic solutions of 1 to 3 per cent tannic acid have been used. It is apparently safe. It does not produce necrosis, it does not destroy the silk sutures which are holding the structures properly and, in experimental and clinical work, it does result in marked fibroplastic proliferation. These facts seem of sufficient importance to make this procedure a routine part of the operative repair of the recurrent inguinal hernia.

During the past 4 years the injection of irritant fluids has been used in 66 hernia repairs, 14 of which were recurrent hernias. The follow-up of these patients has not been satisfactory as only 37 per cent have responded to the follow-up letter or returned for examinations. However, no recurrences have been recorded in those whom we have been able to follow. By producing larger amounts of fibrous tissue union between the sutured tissues instead of the small amount which follows the usual hernia repair it is believed that a much firmer more lasting inguinal wall may be developed and that the percentage of recurrences will be reduced.

Today there is no such thing as an irreparable inguinal hernia, *per se* if all the facilities at our disposal are utilized. The irreparable inguinal hernia is found only in the patient who because of other pathology such as cardiac or pulmonary disease is not a reasonably safe operative risk. Ample evidence of this fact is demonstrated by operative cure of inguinal hernia after three or four recurrences.

The surgeon may not be able greatly to alter the poor physical condition of the patient and the problem presented by lack of human material with which to work. He can, however, in the choice of materials and of the type of operation to use and in his attention to details, decrease the number of recurrences. In the choice of materials he must determine as accurately as possible beforehand the desirability of fascia lata sutures or a large fascia lata transplant, and make provision for obtaining this material quickly and aseptically if at the time of operation his pre-operative conclusions as to its need are substan-

tiated. Having chosen the proper suture material, and having carefully fitted the technique to the condition present, the surgeon can still add to the durability of the repair by the injection of irritant fluids to stimulate the production of fibroblasts with a resulting firmer union of the tissues which have been sutured.

#### SUMMARY

A report is made of 165 cases of recurrent inguinal hernias in which patients have been operated upon during the past 9 years. The problem of recurrence is not to be laid entirely at the feet of the surgeon so many factors are involved and the contribution of the patient is not to be minimized.

The majority of recurrences are in laboring people past the age of 40 years. Malnutrition as well as obesity may be a factor of importance in recurrence.

The selection of proper suture material is of great importance. Sufficient evidence experimental and clinical, indicates the need of non-absorbable sutures. Interrupted fine silk has been the preference for the past 5 years and has been used routinely.

It is believed that many recurrences are due to lack of sufficient fibrous tissue union between the muscle and fascia which were satisfactorily sutured. Believing that an added stimulus to fibroplasia is necessary to secure firmer and lasting union, the injection of irritant fluids during and after operation has been carried out as described. The result has been to strengthen the line of suture and thus to reduce the number of recurrences.

The routine adoption of this method of artificial fibroplasia stimulation is recommended in the treatment of inguinal hernia.

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# A DEVICE FOR MAKING ACCURATE ROENTGENOGRAMS OF THE NECK OF THE FEMUR DURING REDUCTION

HUGH MCKENNA M.D. F.A.C.S. Chicago, Illinois

**A**n important advantage in the successful treatment of intracapsular fractures of the neck of the femur lies in a procedure that permits accurate roentgenographic views to be taken during the stages of reduction.

Roentgenologists have developed a special technique for securing lateral views of the neck of the femur but, unfortunately, the position must be changed if the surgeon desires to put the extremity in extension for permanent treatment. Therefore, when the alignment of the fragments has been secured, as determined by roentgenograms, the problem of paramount importance is to maintain this position which can be accomplished most accurately if the parts are not moved in securing permanent immobilization. In those fractures that are treated by open reduction it is undesirable to do other manipulation than traction after the surgical procedure is begun. The necessity of developing a method of technique that would permit the attainment of a film showing a true lateral view of the neck of the femur led me to work on this problem. I am therefore presenting the equipment that has been developed and which we believe will enable us to secure not only an accurate alignment of the fracture in the anteroposterior position (that presents little difficulty) but an equally accurate lateral view of the neck of the femur.

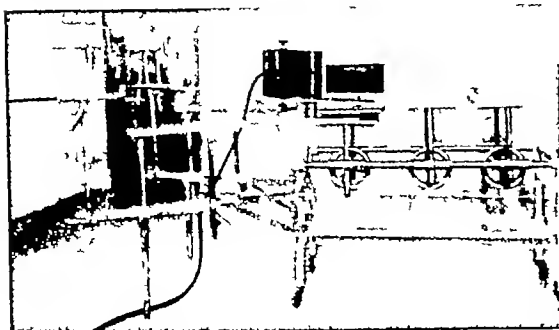
The advantage of this plan lies in the fact that alignment may be secured by attaching the feet in the foot pieces of the fracture table and placing the lower extremities in abduction traction while the foot of the affected limb is turned in internal rotation. The measurement of the lower extremities is made and when roentgenograms show correct alignment of the fragments, no further movement of the extremity is necessary and treatment by either the closed or open method may proceed.

A long series of trials, utilizing the old metal perineal post, was carried out with a wooden cassette holder and with the present one constructed with bakelite. While we were able to secure fairly satisfactory roentgenographic views with this equipment, we were never certain that a satisfactory lateral view of the neck could be secured. We found that in an attempt to secure

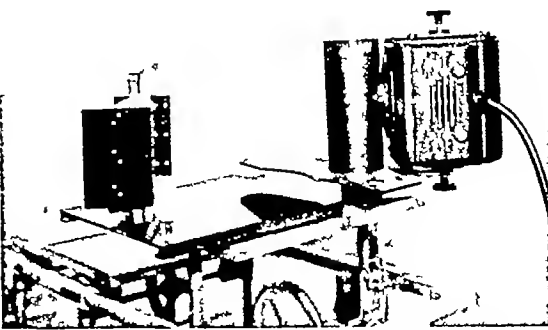
a satisfactory lateral view of the neck of the femur we were confronted with the following difficulties: (1) the inability to place the roentgen-ray tube low enough to secure a true lateral view (2) the problem of arranging the tube at the proper angle without producing marked distortion of the head and neck (3) the difficulty in obtaining a view on account of the position of the metal perineal post. However, the greatest difficulty was the inability to secure a lateral view during reduction and treatment by the open method. In such a surgical procedure, in which asepsis is paramount, an attempt to place the roentgen-ray tube in a position to secure a lateral view was impractical. Our experience led to the conclusion that in order to secure a roentgenogram showing a true lateral view of the neck of the femur without moving the broken fragments after alignment, the following mechanical arrangement must be carried out: ( ) the roentgen-ray unit is securely fastened to the horizontal plate of the supporting perineal post between the legs of the patient at a plane passing through the neck, great trochanter and head of the femur ( ) A small cone of the roentgen-ray tube passes through an opening in the perineal post. Our experience showed that the direct beam of the roentgen-ray tube passes through the post at an angle of approximately 45 degrees from the midsagittal plane. These conditions have been fulfilled by the device described in this article. It will be noted that the cassette holders, shown in this paper have been built to fit my fracture table, which lends itself to the various positions required to secure both views described in the accompanying legends.

The perineal post has been constructed of a steel framework with a horizontal steel plate through which a steel cylinder emerges at a right angle and over which a perineal post made of a second steel cylinder covered with bakelite, telescopes. A hole is made large enough to permit the cone of the roentgen-ray tube to pass through the post with the exception of the bakelite surface in contact with the soft tissue.

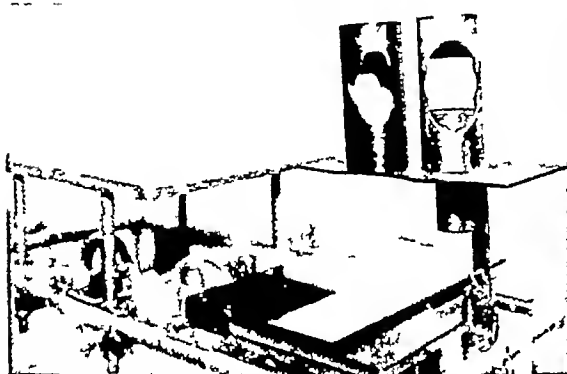
The post may be revolved to take a picture of the neck of the femur on either side. The horizontal steel plate acts as a supporting structure for the pelvis on one side of the upright post and



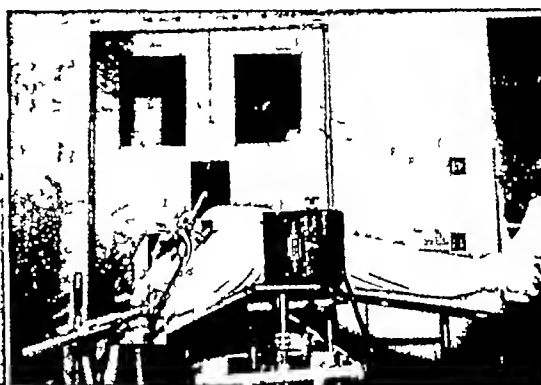
1 Fracture table with roentgen ray unit attached to the perineal post, upright cassette holder in position



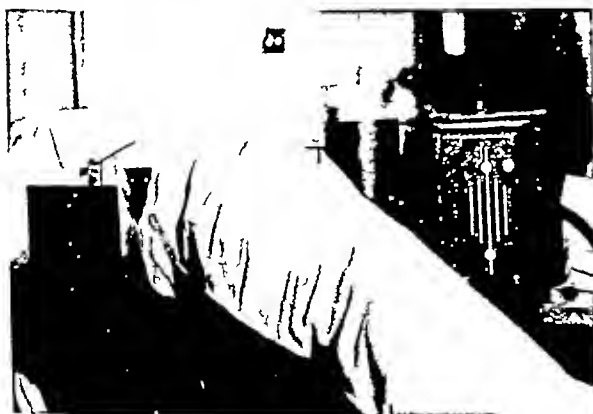
2 Close up view of the upright cassette in the holder Perineal post and roentgen ray unit



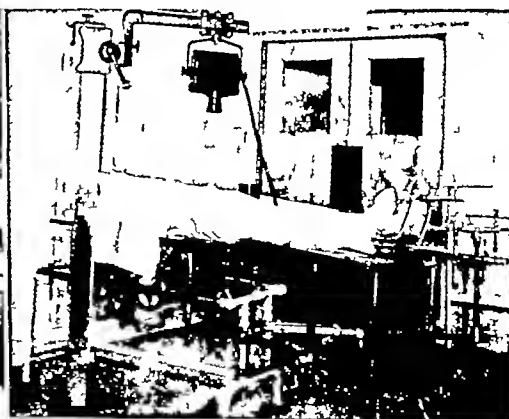
3 Cassette in the horizontal holder in position for anteroposterior view on the lumbar segment of the fracture table, perineal post not assembled



4 View of the roentgen ray unit between the abducted legs, no interference with the position of the assistant



5 The roentgen ray unit in position for a lateral view of the neck of the femur with upright cassette held at proper angle



6 Roentgen ray unit in position for an anteroposterior view with the cassette in holder under right hip

projects to the other side for a distance sufficient to form a supporting framework to hold the roentgen-ray unit. For this work we have used a model

F3, General Electric type of roentgen-ray apparatus, securing the unit in its insulated casing to the horizontal plate of the perineal post at a proper

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# SURGICAL TREATMENT OF ECTOPIC TESTES

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HARRY C. CURTIS, M D, C M, F A C S, Hamilton, Bermuda

**E**CTOPIC testis is the term applied to abnormal displacement of the gland in the course of descent. Unilateral ectopia is far from common, and bilateral ectopia is extremely rare. Sometimes the testis descends as far as the outlet of the inguinal canal and thence deviates to some abnormal position, most commonly to the perineum (ectopia perinealis). These aberrant glands have also been found at the penoscrotal junction (ectopia penalis), in Scarpa's triangle (ectopia cruralis) and toward the anterior superior spine of the ilium on the superficial surface of the aponeurosis of the external oblique muscle (ectopia inguinalis interstitialis). Both testicles may descend by the same inguinal canal (ectopia transversa), a condition usually associated with pseudohermaphroditism. Rarely a testicle will descend into the true pelvis (ectopia pelvis).

Ectopia testis is to be distinguished from cryptorchidism, which is the term applied to retention of the testis at some point in its normal descent.

## DESCENT OF THE TESTIS

The position finally occupied by the testes is very different from that which they possess in the earlier stages of development.

During the first stages of intra-uterine life, the testes develop in the abdominal cavity, posterior to the peritoneum, by which they are covered only in front and at the sides. They are at first elongated structures, extending below the diaphragm. Their cranial portions atrophy and their caudal ends grow.

By the end of the third month, the testes lie in the mid abdomen being connected with the anterior abdominal wall by four attachments: the mesorchium, or epigonal portion of the genital fold, the inguinal fold, and, finally, by the inguinal crest. Within the fold thus formed there gradually appears, at first in separate parts, a cord of closely compacted spindle-shaped cells which extends from the caudal end of the testis through the inguinal canal to the scrotal integument. This cord is known as the gubernaculum testis—the

structure which guides the testis from the abdomen into the scrotum. It begins to grow at about the third month. As fetal development proceeds, the lower section of the gubernaculum enlarges, but above, degeneration and atrophy take place.

At about the time the gubernaculum begins to develop, a sac-like pocket—the processus vaginalis—appears in each side of the anterior abdominal wall. During the sixth month, these peritoneal prolongations evaginate through the abdominal wall and inguinal canal into the scrotum, preceding the testes.

During the seventh to the ninth months, the testis descends into the scrotum by a complex process in which the gubernaculum apparently plays an important part. The descent is accomplished by atrophy and contraction of the gubernaculum, the resulting shortening serving to draw the testis into the scrotum, and by intra-abdominal pressure. Since the gubernaculum and testis are retroperitoneal in position, they remain beneath the posterior wall of the processus vaginalis, the testis being covered, after descent, by a reflected fold of the processus.

The narrow canal which connects the processus vaginalis with the abdominal cavity closes, the now isolated vaginal sac becoming the tunica vaginalis, the serous investment of the testis. Of the upper opening of the processus vaginalis, there remains but a frail thread which may be traced along the spermatic duct, where it mingles with the tissues forming the spermatic cord. Sometimes, however, the canal fails to close, or disappears only in part, thus giving rise to congenital hernia, for if this peritoneal pouch remains open, the tunica vaginalis has a free communication with the general peritoneal cavity.

As the testis descends, it carries with the ductus deferens (primitive mesonephric duct), the spermatic vessels and the lymphatics, these, with their surrounding connective tissue constitute the spermatic cord.

Descent of the testes is normally complete at birth. Interference with development from whatever cause, may bring to bear influences which will retain them in the abdominal cavity or within the inguinal canal. When this occurs we have

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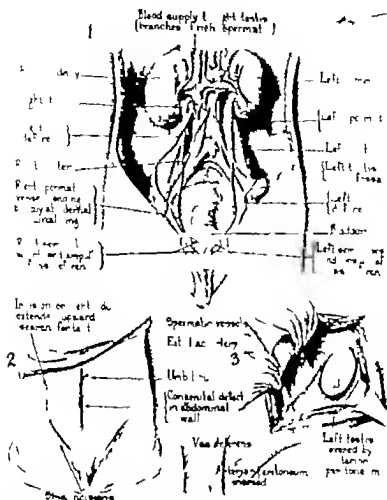


Fig. Condition present. Right testis in region of hilum of right kidney. Blood supply from spermatics by way of small branches. Main trunks of spermatics ended blood in region of external inguinal ring. Left testis as found in region of iliac fossa. 2, Position of right testis exposed. Incision on the right side as extended upward. 3, Show left testis exposed and found to be in iliac fossa. Covered by the posterior peritoneum.

the condition known as cryptorchidism. If, on the other hand, the testis descends to the outlet of the inguinal canal and thence deviates to some abnormal position, we have ectopic testes.

#### INFLUENCE OF HORMONES ON TESTICULAR DESCENT

The mechanism of testicular descent, as described has been accepted for many years, but later investigations seem to indicate that the descent of the testis may be influenced materially by hormones developed during the growth of the

child. The fact that it has been observed usually that the testes in cryptorchidism sometimes descend following the injection of a suitable dose of gonadotropic hormone would seem to require consideration of the phenomena of descent.

It is known that the testes do not descend in mice and rats until puberty, which suggests the possibility that the male hormone exerts an influence on testicular descent in these animals. Additional strength is given to this view by the knowledge that in certain rodent the testes remain in the abdomen and descend only during the

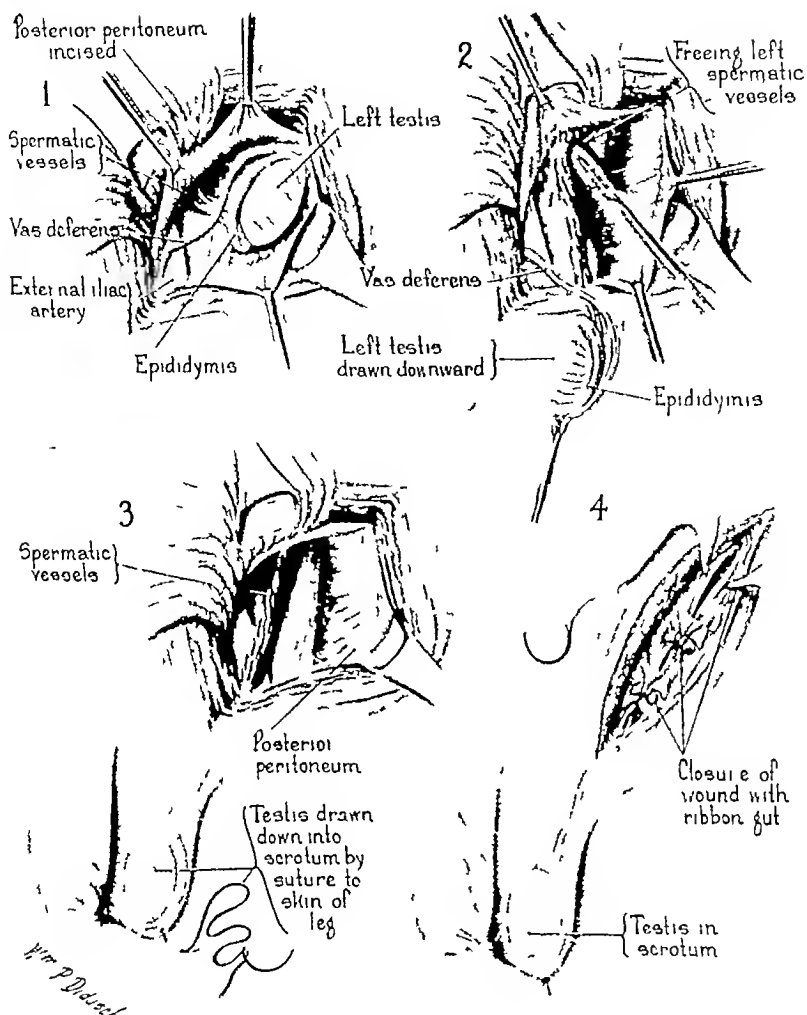


Fig 2 1, Posterior peritoneum incised to expose left testis, vas deferens, and spermatic vessels 2, Freeing spermatic vessels Testis drawn downward 3, Testis in scrotum. Suture placed in skin of leg to hold testis down in scrotum 4, Suture of wound with ribbon gut

...tting season It is also known that wide separation of the pubic ligaments, similar to that occurring in the pregnant state, may take place in non-pregnant female guinea pigs following the artificial injection of the normal ovarian hormone (folliculin), and scrotal hernia has been known to develop in mice treated with the ovarian hormone (estrin, folliculin) Kojama showed that testicular descent does not occur in hypophysectomized immature male animals, and Rose observed that covering the gubernaculum in experimental animals was followed by normal descent of the testes in the majority of cases It is difficult to recon-

cile these facts with the generally accepted theory of testicular descent.

Probably several factors contribute to the normal descent of the testes Undoubtedly, the hormonal factor is of great importance In addition, the development of the scrotum and its investing pouches, the gubernaculum, the loosening and the subsequent closing of the rings of the inguinal canal, the actual and relative growth of the body with that of the testes, external pressure, and increased intra-abdominal pressure, all these may influence the normal descent of the testes



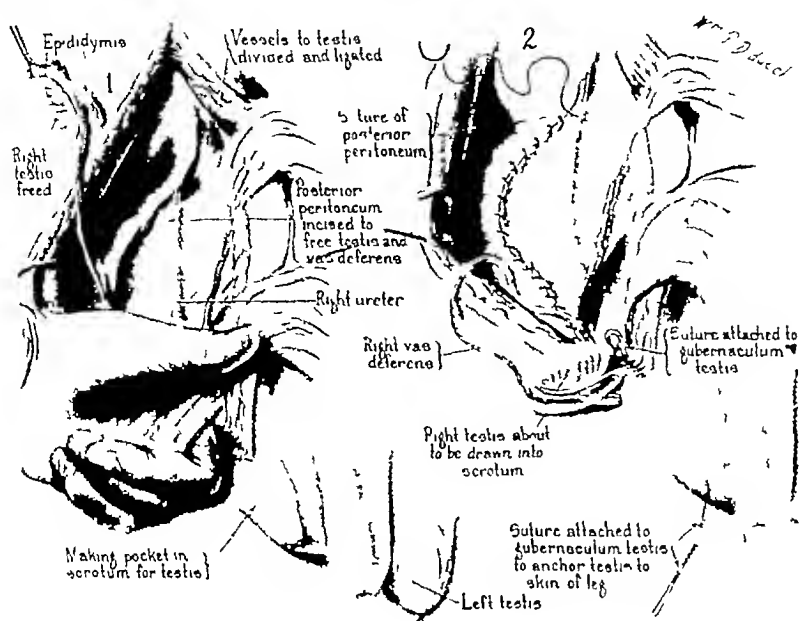


Fig. 4. 1, Testis and vas deferens on right side freed. Posterior peritoneum was incised to free vas deferens. A pocket to receive testis was made in the scrotum. Left testis is shown in the scrotum. 2, Suture attached to gubernaculum testis is drawn through the scrotum and placed into the skin of the leg to hold the testis in the scrotum. Above is shown the closure of the posterior peritoneum.

sent. The degenerative changes in undescended testes become increasingly recognizable as puberty is approached. Dissolution and atrophy of seminiferous tubules gradually take place, but interstitial cells of Leydig are apparently not influenced by the abnormal position.

Retention of both testes is usually

generation than is the normally placed organ. Associated nervous disorders are common. Boys with this defect often become neurotic, especially if they are not relieved before puberty. Adults sometimes fear lack of sexual power and the ability to reproduce, and may become depressed and morose on this account. Reduction of the





hyalinization of the tubules The interstitial tissue in the cryptorchid testes in both the treated and control animals was increased in amount Often there was considerable edema of the interstitial tissue These changes were most marked in the injected animals It is the opinion of these authors that the surgical correction of undescended testes after hormonal treatment is not facilitated, as claimed by many, but is rendered more difficult, due to the increased number and thickness of adhesions

#### INDICATIONS FOR OPERATION

Indiscriminate sacrifice of the undescended or ectopic testis is unwarranted since, with care, most of these organs can be satisfactorily reduced and the accompanying hernia repaired Even atrophic testes, with questionable spermatogenesis, should be conserved for the influence they may exert on the development of the secondary sex characteristics

Early operation, in those cases in which the testis or testes fail to descend spontaneously, is important for a number of reasons (1) the undescended testis is more liable to suffer trauma, torsion, and malignant degeneration than the normally placed organ, (2) the scrotal position appears to be necessary for the complete anatomical and physiological development of the testes, (3) the accompanying inguinal hernia, if left untreated, is a potential danger to life, (4) acute infections in an undescended testis are even more distressing and menacing than those in the normally placed gland, (5) the nervous disorders and neurotic states that often accompany this anomaly, usually clear up following reduction of the testis to its normal position

#### AGE AT WHICH TO OPERATE

While there is general concurrence among authors that the attempt to reduce the testis should be made during childhood, opinions differ regarding the age at which the operation can be carried out with the greatest safety and assurance of success

It is our belief that children under 4 years of age do not stand operation well, but that any time after that age is suitable for surgical correction of this anomaly Certainly the procedure should be done before the onset of puberty If orchidopexy is performed before puberty, one may expect the undescended testis to be equal or nearly equal in size to its normally placed fellow, but if operation is delayed beyond puberty, the testis will usually be found to be atrophic and incapable of spermatogenesis

#### TECHNIQUE

Orchidopexy, to be successful, must (1) preserve the blood and nerve supply of the testis, (2) fix the gland in the bottom of the scrotum without undue traction of the cord, and (3) cure the hernia that almost always accompanies this condition

Many operations for the correction of undescended testes have been devised In most common use are the procedures of Bevan and Torek In the former, retraction of the testis is prevented by a pursestring suture at the neck of the scrotum, in the latter, the testis is sutured to the fascia lata of the thigh, from which it is detached, and the scrotum and thigh are separated, at a later operation The procedure preferred by us is a modification of the Torek operation

The authors were recently called upon to operate upon a case that was so remarkable that it seems appropriate to describe it in detail

A colored man, aged 33 years, presented himself to Dr E A Cann, of Somerset, Bermuda, 4 years before admission, suffering from an acute Neisserian infection of the urethra During the course of this disease, he developed prostatitis and double epididymitis, with pain in the region of the rectum and acute pain in the midline of the abdomen This subsided in approximately 1 week, but the prostatitis recurred on two different occasions thereafter During the last attack of prostatitis, sulfanilamide was used, which brought about prompt relief, and no further trouble had been noted The patient was normal sexually

Physical examination showed the patient to be a slightly built colored male Pupils reacted to light and accommodation The tongue was clean and moist Teeth were in fair condition The throat was clear There was no swelling or pulsation noted in the neck The heart and lungs were normal The abdomen was flat The scrotum was empty, the testes were not palpable either in the scrotum or in the inguinal canals There were no hernias The kneejerks were normal and there was no abnormality of the neuromuscular system

Under ether anesthesia, a 10 centimeter incision was made obliquely upward and outward from the spine of the pubis over the left inguinal ring The fascia was incised and the incision deepened into the inguinal canal The bladder was inadvertently incised but was immediately closed with a double layer of chromic catgut, sutured, and drained The peritoneum was then opened and, after considerable search, a testis was located in the left iliac fossa outside of the iliac vessels The testis was mobilized, it being necessary to tie off several aberrant vessels in the process The vas was found to be ample in length, the main mass of vessels forming the cord were held in a tight fibrous envelope This was excised, after which the vessels were found to be sufficiently long to let the testis be brought into the left scrotum, where it was fixed with a double chromic catgut suture, passed through the scrotal sac and fixed to the skin of the thigh The peritoneum was closed with plain catgut No 2, the inguinal canal was closed with interrupted chromic ribbon gut, the fascia with chromic catgut No 2, and the skin with metal clips

On the right side, a 10 centimeter incision was made, extending from the anterior superior spine of the right pubis obliquely outward and similar to the incision on the oppo-

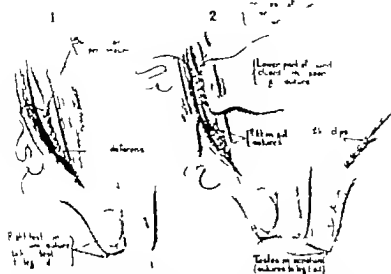


Fig. 5. Right testis in scrotum. Suture to left testis. Closure of anterior peritoneum. Vas deferens in lower angle of wound. Both testes are shown in the scrotum. Closure of the lower part of the wound. Lith ribbon got. Closure of upper part with silk suture. Skin closed. Lith clip.

normally situated glands to suffer trauma, torsion or malignant degeneration.

#### HORMONAL THERAPY

Attempting to bring undescended testes into their proper position in the scrotum by use of gonadotropic hormones derived from the anterior lobe of the pituitary gland and similarly acting water soluble substances derived from the urine of pregnant women has many enthusiastic advocates.

It is our belief that endocrine therapy with gonadotropic hormones is not only valueless in effecting descent of a testis but, in larger doses, is definitely harmful to undescended testes. True undescended and ectopic testes, which are fixed in their abnormal position will not descend into the scrotum with hormonal treatment but require operation for their correction. Testes that do descend following injection are the type of abnormally situated glands which in animals will descend spontaneously—usually about the time of puberty. That this point of view is becoming more common among those who have utilized this form of therapy is evident from the literature.

Of particular interest in this regard, are the recent experiments of Eisenstaedt, Appel and Fraenkel on rats. In these the experimental

animals showed a characteristic response to hormonal treatment when the testes had been made cryptorchid. The gross appearance of these testes corresponded closely to that of human undescended testes which had received larger doses of hormone (approximately 6,000 rat units) and which subsequently required operation to overcome a mechanical cause for their failure to descend. The most striking changes were in the capsule and the seminiferous tubules. Dense fibrous adhesions were present between the visceral and parietal layers of the tunica vaginalis, and there was marked thickening of the tunica albuginea—changes which were not observed in the cryptorchid testes of uninjected control animals. Changes in the tubular epithelium consisted in a decrease in the number of the sex elements and failure of their development. There was complete absence of spermatids and mature sperms, and the tubules were shrunken and atrophic, and filled with Sertoli cells and spermatogonia. Occasional partially or completely hyalinized tubules were observed through the section. Similar but much less marked changes were seen in the untreated cryptorchid testes used as controls. The tubules of these contained many spermatogonia and spermatocytes and occasionally mature sperms, with no evidence of

# BREECH DELIVERY

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**A**N average of about 150 babies per month are delivered on the obstetrical service of the St. Louis City Hospital. During the last 5 years, from August, 1934 to August, 1939, there have been 291 breech single pregnancy deliveries, and it is this group with which this paper is concerned. The incidence of breech delivery was about 1 in 30.

Of the 291 breech deliveries, 97, or 33.3 per cent, were in primiparous mothers and 194, or 66.6 per cent, in multiparous mothers.

In this series there were 71 premature infants, weighing less than 2,500 grams—24.4 per cent of the entire series, and 220 mature babies—75.6 per cent. One-half of the newborn in this series weighed between 2,500 and 3,500 grams. The largest baby in the series weighed 4,700 grams (Table I).

It was the practice in this series to allow the child to be born to the umbilicus before any active assistance was instituted. There were isolated instances in which the breech was broken up and active interference instituted early. The delivery of the aftercoming head was usually attempted by the Mauriceau-Smellie-Veit maneuver and occasionally by the Martin-Weigand maneuver. Failing in these, forceps were applied. The Piper forceps was the instrument of choice.

**Fetal mortality.** In correcting the gross fetal mortality rates for the mature breech infants, elimination depends upon the following conditions being present: (1) Prematurity, in which the dividing line is 2,500 grams, (2) macerated stillbirths, (3) congenital anomalies, (4) stillbirths where the fetal heart was not heard prior to labor, (5) deaths after the neonatal period, which is considered 2 weeks, (6) syphilis, active.

Of the 97 primiparous breech deliveries, the gross uncorrected fetal mortality was 26, or 26.79 per cent. Of this number, 18 can be eliminated which leaves a corrected primiparous fetal mortality of 8, or 8.25 per cent. Of the 194 multiparous breech deliveries the gross uncorrected fetal mortality was 56, or 28.85 per cent. All of these can be excluded except 9 for a corrected multiparous breech fetal mortality of 4.64 per cent. Table II classifies the series according to parity and time of death.

The gross uncorrected mortality for fullterm breech babies was 26, or 11.81 per cent. Of these, 9 can be eliminated, which makes the corrected fetal mortality for fullterm breech babies 5.84 per cent. Of the premature infants, if 2,000 grams were considered the weight of viability, there would be a corrected mortality of 7.42 per cent. When 1,500 grams was considered the weight of viability the corrected mortality rate was 24 per cent. Table III shows this series classified according to maturity and time of death.

**Maternal mortality.** One mother died on the eighth day postpartum of a lobar pneumonia in which the etiological agent was the *Streptococcus hemolyticus*. Postmortem examination confirmed this diagnosis. This makes the maternal death rate for this series 0.34 per cent.

Labor was induced in 4 patients in the entire series. In 3 cases quinine and castor oil were employed, while in a fourth a bag was used.

## TECHNIQUE

As mentioned previously, the majority of the labors were allowed to progress to the birth of the child to the umbilicus. In 10 cases, or 3.4 per cent, the presentation was broken up and active delivery was instituted early. In 2 of these 10 cases there was a dead infant. In only 3 instances of 254 was the "one-man" delivery or the Martin-Weigand maneuver attempted. In all of the others, with the Mauriceau-Smellie-Veit maneuver, care was always exercised not to exert undue traction on the cervical spine of the infant. In only 26 cases were forceps used and in these cases the Piper forceps was the instrument of choice. In all of these cases where forceps were applied and in 10 other deliveries, where large babies were expected, episiotomies were performed.

TABLE I — WEIGHT OF BABY

Weight grams	Number	Per cent
500-1000	15	5.15
1000-1500	11	3.78
1500-2000	21	7.21
2000-2500	23	7.90
2500-3000	64	21.96
3000-3500	81	27.83
3500-4000	54	18.55
4000-4500	18	6.18
4500-5000	4	1.39
Totals	291	100.05

From the St. Louis City Hospital and the Washington University School of Medicine, Department of Obstetrics and Gynecology

site side. This was deepened through the fascia and later extended upward 3 centimeters. The floor of the inguinal canal was opened and the peritoneum incised. The vessels of the cord were visualized but ended blindly at the internal ring of the inguinal canal. The patient was then placed in the Trendelenburg position and the intestines were packed off with abdominal pads. Only by following the vas deferens from its termination in the ampulla of the vas was the testis finally discovered in its retroperitoneal position at the level of the right kidney hilum, where it developed in embryo. In other words, the testis had not descended at all. The posterior layer of the peritoneum was incised and the testis and vas isolated. Unfortunately the regular blood supply was entirely lacking; it ended blindly at the internal inguinal ring. The testis was entirely supplied by aberrant vessels, which had to be tied off, leaving the artery and veins of the vas, which Devine had repeatedly stated are sufficient to maintain the organ. The testis was reduced without difficulty to its proper place in the scrotum, here it was fixed to the thigh in the manner

already described. The posterior peritoneum was closed with plain No. catgut, as was the anterior layer the muscle with interrupted chromic catgut No. 1 and the floor of the inguinal canal with chromic ribboncat. The fascia was closed with chromic catgut No. 1 and the skin with metal clips.

Unfortunately this patient had very stormy post-operative course and finally expired from myocardial failure.

#### CONCLUSIONS

It is our opinion, that ectopic testes is an operable condition. The testes may be successfully reduced in a viable condition to their proper places in the scrotum and fixed to the skin of the thighs by means of chromic catgut anchor stitches. It is advisable to operate on such patients before manifestations of puberty are present.

Two hundred and fifty-three infants were born alive. There were 44 neonatal or postnatal deaths which left 209 infants living for this study. Of the 209 living infants, 182, or 87 per cent, responded with a spontaneous cry and respiration. Respiration was delayed in 27 or 13 per cent, although resuscitation was possible. Of the 44 neonatal and postnatal deaths, only 28 or 63.63 per cent responded with spontaneous cry and respiration. Sixteen or 36.37 per cent were delayed and required resuscitation. It is quite interesting to note the higher incidence of resuscitation among the latter group.

In this series the practice of instituting delivery late made the method of delivery fairly uniform. In 3.4 per cent of the entire series the presentation was broken up and active delivery started early. In 2 of these 10 cases a dead infant was born. The Mauriceau-Smellie-Veit maneuver was used most frequently but care was exercised not to exert great traction on the cervical spine of the infant.

Table V demonstrates the conditions associated with fetal death in the 17 cases of corrected fetal mortality. In retrospect we can criticize the fetal deaths associated with an undilated cervix and

with contracted pelvis. Possibly these babies might not have been lost if strict adherence to the fundamental prerequisites for delivery had been followed.

The seven fetal deaths associated with intracranial injury are more difficult to analyze. It is accepted that intracranial injury does not occur more frequently with breech delivery, but possibly more absolute adherence to the necessity for extreme gentleness might have eliminated some, if not all, of these deaths.

#### SUMMARY

A series of 291 breech deliveries occurring in the St. Louis City Hospital over a 5 year period are reviewed.

The method of delivery and the delivery personnel was fairly constant.

Of the corrected figures, in retrospect, some if not all but 3 deaths might have been avoided, to give an ideal fetal mortality rate of 1.03 per cent.

Failure to adhere to the primary requirements of delivery—gentleness and complete dilatation—and faulty judgment in method of delivery were responsible for the 4.81 per cent mortality.

TABLE II.—FETAL MORTALITY BY PARITY

Parity	Primipara	Multipara	Total
Total deaths	97	194	291
Macerated stillborn	5	4	9
Stillborn	3	4	7
Neonatal deaths	4	3	7
Postnatal deaths	26	50	76
Total deaths	38	57	95
Corrected	26	47	73
Per cent mortality uncorrected	39.29	29.38	34.38
Per cent mortality corrected	26.84	24.23	25.54

TABLE IV.—COMPLICATIONS OF PREGNANCY

	21	22	Total
Toxemia			
Pre-eclampsia	20		20
Eclampsia	3		3
Low reserve kidney			
Syphilis	3		3
Placenta previa	4		4
Pyloric	4		4
Tuberculosis			
Bronchiectasis			
Polypyroneuria			
Rickets			
Gonorrhea			
Malaria			
Bartholinitis			
Total			55

The first year internes, in delivering 307 breeches had a gross mortality of 59, or 19.5 per cent. Of these 52 can be excluded, leaving a corrected mortality of 3.38 per cent. Among the assistant residents who delivered 63 breeches the gross mortality was 16, or 25.38 per cent. The corrected rate for the assistant residents was 9, or 14.28 per cent. The resident obstetrician handled only 16 breech deliveries. There were 7 deaths, or a gross mortality of 43.75 per cent. This was corrected and gave the residents a corrected mortality rate of 1, or 6.25 per cent. These discrepancies may be explained by the fact that the assistant residents and resident obstetricians must shoulder the responsibility of difficult deliveries which the first year interne does not have to handle. Table 4 classifies this series according to delivery personnel.

**Complications.** Table IV shows the complications of pregnancy noted in this series. There were 24 cases of toxemia. Of these, pre-eclampsia was found in 20 instances. There were 3 syphilitic mothers, some of whom had received treatment. One syphilitic child was born. In one case of polyhydramnios an anencephalic monster was delivered by breech.

A prolapsed cord was encountered in 5 cases without the loss of a child. One case of hydrocephalus was delivered by craniotomy. Retained placentas were noted 9 times in this series, but in only 5 was manual removal necessary. There were 3 cases in which the cord was wrapped about the neck and in all of these the baby was born dead, although the fetal heart was distinctly

heard prior to delivery. In 1 case a prolapsed arm was a complication but this was handled by returning the arm and a live baby resulted. In all cases in which the gloved hand entered the uterine cavity in which a macerated stillborn was delivered, or in severe postpartum hemorrhage, an intra uterine douche consisting of 1,450 cubic centimeters of 1:1000 potassium permanganate and 50 cubic centimeters of normal sulphuric acid was given. In this series, 19 were administered.

There were 36 tears obtained in delivery of which 20 were first degree minor in extent, and required no repair. Nine were first degree, and 7 were second degree and required repair. There were no third degree tears. In 36 cases an episiotomy was performed. In all of the repairs of the perineal lacerations and episiotomies, healing was fairly uniform by primary intention and no secondary closures were necessary.

**Anesthesia and analgesia.** In this series 16 mothers were given no anesthetic. Of the 275 receiving anesthetics, the types of drug used varied with the trend of the times. Nitrous oxide and oxygen was used in 26 cases; ether in 28, chloroform in 8, spinal block in 2, procaine local anesthesia, in 1.

In 58 of the 75 mothers who received anesthesia, some form of semibarbiturate was also used. Various combinations of drugs gave varying success. Hyoscine with various other analgesic drugs was the most popular. Second-hyoscine was used in 5 cases, dilaudid-hyoscine in 1 case, nembutal in 6 cases, sodium orol in 8 cases, morphine-hyoscine in 6 cases, and luminal in 1 case.

TABLE III.—FETAL MORTALITY BY MATURITY

Maturity	Preterm	Full term	Total
Total deliveries	7	30	37
Macerated stillborn	0	3	3
Stillborn		4	4
Neonatal deaths	24	3	27
Postnatal deaths	0	7	7
Total deaths	24	10	34
Corrected	24	9	33
Per cent mortality uncorrected	34.28	33.33	33.81
Per cent mortality corrected	34.28	30.00	32.43

TABLE V.—CAUSE OF CORRECTED FETAL MORTALITY

Cause	Cases
Intrauterine injury	7
Undilated cervix	3
Cord about neck	5
Contracted pelvis	3
Obesity	—
Total	7

tirely unwarranted. No one can deny, of course, that some patients are injured so critically as to contra-indicate any type of treatment directed toward the repair of facial wounds.

In the care of lacerated wounds of the face, it has been repeatedly demonstrated that satisfactory results may be anticipated when the immediate treatment consists of proper débridement, excision of ragged and macerated skin margins, complete hemostasis, adequate drainage, the use of a minimal amount of catgut, the insertion of fine skin suture material, the careful approximation of skin edges and the application of a pressure dressing. A significant advance in the management of facial injuries involving large regions denuded of skin is the prevention of severe scarring and distorting contractures by the immediate application of free skin grafts to those raw surfaces that are not grossly contaminated. Because the skin covering the auricle and mastoid process is almost identical in color with that of the face, dermal grafts taken from the posterior surface of the ears are particularly valuable for use about the eyelids. In traumatic facial surgery, one error in technique which is inexcusable is the failure to remove from abraded and lacerated surfaces, dirt, powder marks, and other pigmented foreign material by vigorous scrubbing with a stiff brush, soap and water. If permitted to remain in a wound, such foreign substances leave a permanent tattoo-like pigmentation in the skin which is impossible to remove except by excision.

The early treatment of injuries to the bony structures of the face is never urgent as in the case of wounds of soft tissues. In fact, it is often preferable to defer the reduction and immobilization of fractured facial bones for several days until satisfactory roentgenograms can be secured and until the course of

treatment can be well planned. Many of these fractures require the close co-operation of the maxillofacial and dental surgeons. While the treatment of fractures of the bones of the face is not to be discussed here, one cannot stress sufficiently the importance of recognizing a depressed, uncomminuted, fractured malar bone, a condition which is frequently overlooked because of the excessive swelling of the overlying soft tissues. Although such a displaced zygoma may be elevated readily at the time of the injury, if neglected, a most conspicuous flattening of the cheek eventually occurs which never can be completely corrected by plastic methods. One of the most valuable discoveries of recent years is the use of sulfanilamide in the treatment of badly fractured and depressed nasal bones associated with a fracture of the cribriform plate of the ethmoid bone and exhibiting clinically a cerebrospinal rhinorrhea. By this drug, many individuals with such naso-ethmoid injuries have been saved from a fatal meningitis.

Those who are not familiar with the accepted operative methods recommended in the primary care of traumatic facial wounds will find in medical journals of the past few years many instructive articles written by men of prominence in the fields of maxillofacial and plastic surgery. However, in surveying the literature, one encounters certain difficulties, the most perplexing of which is the discovery that a great many procedures are described for the correction of the same type of injury. Although such methods are often contradictory in principle, the objective of each is identical. It has been suggested that this lack of uniformity causes many doctors considerable difficulty in selecting the most suitable method or methods of treatment to be employed in any specified case. However, diversity of techniques or plans of approach does not destroy the fundamental principles





struction One reason for the dearth of careful morbidity studies is the difficulty of setting up significant standards Death is very real, and one can deal with it both statistically and scientifically Morbidity is difficult to evaluate, and a true picture can be framed only after the lapse of considerable time However, serious attempts should be made to set up comparable criteria which can be used to evaluate both immediate and remote results Obviously there are no criteria of fetal morbidity aside from those which occur in the neonatal period Few, if any, attempts have been made to apply standards of morbidity to the newborn

It should be possible to develop certain comparable standards for mothers and newborns at least for those conditions which frequently lead to death For the mothers the chief causes of death are infection, toxemias, hemorrhage, and trauma For the infants they are malformation, trauma infection nutritive and thermal disturbances Attempts have been made to set up a generally acceptable standard of febrile morbidity This could not be an absolute standard for the incidence of infection and has only the value of comparison The usefulness of such a standard is slight unless it is generally followed, and yet it is extremely difficult to secure the recognition and application of such a standard of febrile morbidity as was promulgated by the American Committee on Maternal Welfare It simply attempted to iron out some of the minor differences in many of the existing

standards with the hope that it might come to be acceptable A workable classification of the toxemias approved by many workers has been adopted, and it should be possible to develop some standards of morbidity for comparative studies Other criteria are needed for nutrition, anemia, blood loss, trauma, etc., which would assist in making comparative studies and enable clinicians to evaluate the methods of prevention and treatment The same plan should be applied to the newborn in order to establish better methods of care of both premature and mature infants Such a commonplace problem as the establishment and maintenance of breast feeding seems to be by no means finally settled The prevention of skin and gastro-intestinal infections in the newborn nurseries is one which plagues many institutions The final word has not been said in the elimination of these sporadic diseases which cause morbidity if not mortality and bring discredit upon the institutions The experience of no one individual, and indeed of no institution, is great enough to settle many of these problems Certain reasonable, accurate, and scientific standards should be set so that comparative studies of technique and methods of prevention and cure could be made in different institutions, and some conclusions reached within a relatively short time By such means as these it should be more easily and quickly possible to adopt methods which would result in a minimum of morbidity and mortality and an optimum of health for mothers and infants

FRED L. ADAIR



# TEXTS AND DOCUMENTS

## CATALOGUE OF THE SURGEON GENERAL'S OFFICE LIBRARY, OCTOBER 23, 1865

ARNO B LUCKHARDT, M D , Chicago, Illinois

**F**EW if any people will dispute the statement that The United States of America possesses in the Library of the Surgeon General's Office one of the best, if not the most comprehensive, biomedical libraries of the world

According to the most recent figures available to me, its content as of 1939 comprised some 405,000 volumes and 185,000 theses

In the last report of Major General James C Magee, Surgeon General,<sup>1</sup> there were added to the Library during the year 1939, 250 additional journals, of which 65 were North American, 18 British, 45 South American, 40 German, 19 French, and 17 Italian Twenty-five subscriptions were scattered among Polish, Rumanian, Dutch, Estonian, Scandinavian, Japanese, Arabic, Turkish, Czechoslovakian, and Hungarian Twenty-two additional ones were in Russian, making a grand total of 2,051 journals The inter-library loans to 405 libraries for 1939 numbered 13,128 items

At present the personnel consists of one commissioned officer, the librarian, 2 physicians as principal and senior librarians, one contract surgeon, one chief library assistant, two junior librarians, 19 clerks, 2 messengers, and 2 laborers considered "insufficient to perform its duties of cleaning book stacks and offices"

The Surgeon General believes that the library is becoming the leader in the field of medical bibliography

Years ago, I acquired in book collecting a brochure entitled "Catalogue of the Surgeon General's Office Library" dated October 23, 1865 It proved an interesting item to many friends For

<sup>1</sup>Annual Report of the Surgeon General U S Army 1939  
Washington U S Government Printing Office, 1940 pp 245 248

this reason, I hoped that it might interest the subscribers to this journal as indicating historically the tremendous growth of the library since those early days Bound in boards the catalogue brochure measures 4¾ inches by 7½ inches The title page is here reproduced All told these listings cover a total of 285 pages in this pamphlet, enumerating titles of books as follows

- 18 on Physiology shown in accompanying illustration
- 20 on Materia Medica, Pharmacy and Therapeutics
- 116 on Pathology and Practice of Medicine
- 120 on Surgery
- 20 on Midwifery and Diseases of Women and Children
- 72 on Medical Jurisprudence, Hygiene, Medical Police, and Statistics
- 34 on Natural Philosophy, Chemistry, and Meteorology
- 42 on Chemistry (specifically)
- 37 on Natural History including Zoology, Botany and Geology

479 volumes in 1865 as against 405,000 in 1940

### Journal listings —

- 26 American journals and reviews
- 10 British journals and reviews
- 4 French journals and reviews
- 7 German journals and reviews

47 Journals in 1865 as compared with 2,051 in 1940

Originally it was planned to reprint the entire catalogue in 8 point which would have allowed each physician to survey the very limited holdings of the library in his own field of activity at that early date Fearing editorial objection because of the expense and space, it was decided to limit the presentation with the comparative statistical data just given

Surely Dr William Beaumont could not get much assistance when 33 years before he consulted it for bibliographical help on the physiology of the digestion, for at that earlier period it was obviously still smaller

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

**I**N his volume on the *Principles of Surgical Care* Blalock has little in common with the older and more familiar types of surgical textbooks. A few pages are devoted to the general principles of surgical technique, such as the careful handling of tissues, asepsis, hemostasis, and the preservation of blood supply but there are no detailed descriptions nor illustrations of surgical operations.

Considerable space is given to anesthesia and anesthetic agents, but attention is directed chiefly to pre-operative and postoperative care. Particular consideration is given to circulatory disturbances which may precede or follow operations. This naturally leads to an extended discussion of shock, a subject which is close to the author's heart, and upon which he has done much important work.

Faulty metabolism and nutrition, and errors in supply and exchange of fluid and electrolytes are closely related to disturbances in circulation and are fully discussed.

The final chapters are given mainly to pulmonary and abdominal complications with some attention to organs less frequently involved.

The book is concerned primarily with the physiological aspects of surgery and strikingly illustrates the present trend of surgery in that direction.

WILLIAM F. MACFEE.

**T**HE eighth edition of *A Textbook of Histology* by H. E. Jordan initiates its twenty fifth year as a medical text. Each previous edition has been accompanied by certain improvements, and the present issue is not an exception. First, there has been a welcome decrease in size brought about by the omission of a list of illustrations (5 pages), chapter on technique (40 pages) and another on laboratory directions (46 pages). Combined with the use of lighter weight paper these eliminations have resulted in more than a 5 per cent reduction in thickness. On the other hand, there are 37 more pages of actual text than before. A considerable number of new illustrations have been added.

The plan and general substance of the textual presentation remain unchanged, but conscientious revision has effected many alterations and additions. In particular has the recent literature on histology been evaluated and incorporated judiciously. Especially drastic has been the revision of the chapter on blood, while the chapters on muscle, endocrines, female reproductive system and blood vessels have received special revisional attention. A meritorious

new feature is the inclusion of a selected bibliography so handled that the reader may recognize the newer advances at the points where they appear in the text. Professor Jordan's book remains a reliable guide for the medical student in his pursuit of histological information.

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**A** GREAT need of the field of orthopedic surgery has been supplied by Dr. Steadler in producing an authoritative book embracing the modern techniques of the surgery of bones and joints. This book is divided into three main parts: first, general biological, anatomical, pathological, and clinical topics pertaining to orthopedic operations; second, the techniques of orthopedic operations; and third, the indications and end-results in specific orthopedic conditions. The author's long and continued studious search of world literature on orthopedic subjects has enabled him to assemble tested operative techniques of great usefulness. These are presented with clear descriptions enhanced by numerous excellent drawings and photographs. Extensive references to original articles conclude each chapter. Most important of all is the presentation of the author's personal experience with the various operations described. End-results have been carefully analyzed and recorded. Dr. Steadler's critical and painstaking study of orthopedic problems is reflected throughout this volume. *Orthopedic Operations* should be on the shelves of every surgical library available to surgeons and students of all bone and joint conditions.

FREDERICK A. CHANDLER.

**T**HE foreword of *Priests of Lactia, the Story of Obstetrics* is written by Frederick C. Irving and points out that it is the first complete story of obstetrics to be published in English. In his preface Flaxley acknowledges his debt to numerous authorities on medical history and bases his method of approach upon statements of Emerson that "There is properly no history—only biography" and of Carlyle that "History is the essence of innumerable biographies."

The author traces the story through mythologic and anthropologic data to primitive man, and develops his theme in the ancient civilizations of the orient by showing the gradual growth of medical knowledge in general and its relation to midwifery in particular. Beginning with the Greek civilization he takes up the biographic approach with the age of

ORTHOPEDIC OPERATIONS, INDICATIONS, TECHNIQUE, by EUGEN STEADLER. By Arthur Steadler, M. D., F.A.C.S. Springfield, Ill. and Baltimore, Md. Charles C. Thomas Co. 1930.  
PRIESTS OF LACTIA, THE STORY OF OBSTETRICS. By Palmer Flaxley, M.D. C. S. Boston, Little, Brown & Co. 1930.

PRINCIPLES OF SURGICAL CARE, SURVIVAL ON ORGANS PROVIDED BY ALBERT BLALOCK, M.D. St. Louis: The C. V. Mosby Co. 1930.  
A TEXTBOOK OF HISTOLOGY. By Harvey Erwin Jordan, A.M. Ph.D. 8th ed. New York: D. Appleton-Century Co. Inc. 1930.

Hippocrates The progress is noted in the biographic sketches of the ancient obstetrician Soranus of Ephesus and in the authoritative medical writings of Galen, who made little impress upon midwifery although he transmitted uncritically some of the theories and data of his predecessors With the fall of Greek and Roman empires the Galenic teachings came to be accepted as almost infallible in the medical world

The encyclopedic school followed, and it preserved much of the knowledge of the past in the writings and records of Celsus, Pliny, Oribasius, Aetius, and Paul of Aegina

Obstetrics in the Middle Ages is discussed from the viewpoint of the influence of Arabian obstetrics, centering around Avicenna and leading up to the renaissance of midwifery, through the influence of Albertus Magnus With the sixteenth century came some pioneer publications such as *Das Frauenbuchlein* and the *Rosengarten* The latter appeared in English as *The Birth of Mankind*

The influence of Pare is traced in biographic sketches of himself, of Guilleméau, and of Scipio Mercurio The establishment of scientific obstetrics by William Harvey and his followers in Britain, and by Mauriceau and his successors, is related Chronologic biographic sketches are given of the various leaders in different countries, showing their influence upon one another It is unnecessary to stress the influence of the Chamberlens, of Smellie, the Hunters, and the others who followed in rapid succession Tribute is paid to them all and the history of obstetrics in our country is traced biographically from Shippen and Bard to the late Williams

In the second part of the book a different literary scheme is followed, showing the development of the knowledge of anatomy, forceps, midwifery, puerperal fever, and the cesarean operation

The preparation of this valuable and interesting book has entailed an enormous amount of work and ability in selecting important material from the voluminous literature which is listed in 32 pages of bibliography It is well illustrated with the portraits of important personages and with other pertinent illustrations

FRED L ADAIR

PROFESSOR Abbie's *Principles of Anatomy*<sup>1</sup> is "an introduction to human biology", it is designed particularly for those beginners in the study of human anatomy "who come to the study without any preliminary biological training" It is based upon a scheme of treatment in which the requirements of living organisms are presented, then the apparatus evolved to meet the environmental challenge Principles only are taught, details of structure are left to later instruction

The first chapter deals with structure and function in unicellular organisms, and with the increasing

complexities in morphology and physiology that come with the aggregation of cells in the metazoa The third chapter is concerned with the subdivisions of the body, giving the meaning of terms commonly employed in gross anatomy, and is illustrated by diagrammatic figures which are simple but serviceable The fourth chapter introduces the discussion of connective tissues and glands, the more detailed presentation of these being distributed among chapters which cover the several bodily systems The fifth chapter discusses "coverings and linings," i.e., layers epithelial and endothelial, with the special derivatives of each—all, with no great display of ingenuity The sixth chapter presents the standard facts about the skeletal system, from osteogenesis to morphology of individual bones A chapter is devoted to muscles, wherein diagrammatic figures replace the customary pictures of a textbook on gross anatomy The next chapter deals with the histological features of blood cells and the gross anatomy of the heart, the major arteries are named and briefly described Here the diagrams are particularly unfortunate, they would be scarcely understandable to a student who had not already viewed the original elements A chapter each is devoted to the respiratory, excretory, reproductive, and nervous systems The organs of special sense, handled with courageous brevity, are discussed in a separate chapter The fifteenth, which is the closing chapter, is devoted to the glands of internal secretion The discussion is refreshingly dogmatic and avoids controversy which a superabundant literature invites

In general, the volume is a selection of outstanding facts such as might be taken from standard textbooks of anatomy (developmental, microscopic, and gross) and textbooks of physiology It is not particularly illuminating and does not contain many concepts novel to the trained teacher For students in American medical schools it would have little value, but for the college student who plans to study medicine it might be of some use in his course in comparative anatomy as an adjunct to textbooks which chronically disregard the anatomy of the human body

BARRY ANSON

THE *Handbook for Dissectors*<sup>2</sup> is a companion to Professor Grant's *A Method of Anatomy* It is, as the authors state, not a textbook of anatomy, but rather a "guide to the orderly and consecutive display of the structures of the human body" Within the handbook, page and figure numbers refer the student to the larger book By this scheme duplication of description and illustration is avoided The volume is kept to pocket dimensions Only nine figures are used, all of them serve as maps of important topographic features and as guides for skin incisions

The first five chapters cover the five major subdivisions of the body—upper limb, abdomen (in-

<sup>1</sup>THE PRINCIPLES OF ANATOMY, AN INTRODUCTION TO HUMAN BIOLOGY By A. A. Abbie, M.D. B.S. B.Sc. (Syd.) Ph.D (Lond.) Sydney and London Angus & Robertson Ltd 1940

<sup>2</sup>A HANDBOOK FOR DISSECTORS By J. C. Boileau Grant and H. A. Cates A Companion to *A Method of Anatomy* by J. C. Boileau Grant Baltimore The Williams & Wilkins Co 1940

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*Obstetrics Operations, Indications, Technique*, and *End Results*, By Arthur Steindler, M.D., F.A.C.S. Springfield, Ill. and Baltimore, Md.: Charles C. Thomas Co. 1949.  
*Principles of Laceria, the Story of Obstetrics*, By Palmer Findley, M.D., F.A.C.S. Boston: Little, Brown & Co. 1949.

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In general, within the subject matter for each dissection area, the palpable skeletal landmarks are described first, then the related masses of musculature next, anatomic spaces or depressions finally. The important deeper structures as referable to lines drawn upon the body surface.

Directions are given for throwing certain muscles into action in the living body in order to demonstrate form and extent. Vessels, nerves, deep muscles, etc. are presented in their stratified succession. Wherever measuring, pulling, probing, or transecting might aid the director in establishing the position and limits of anatomic structures, these simple but useful devices are clearly suggested.

The style is chatty but not wordy, encouragingly casual. The handbook bears the unmistakable mark

of experienced teaching and of full appreciation of the student difficulties. The best chapters, in the reviewer's opinion, are those dealing with the trembles, the least detailed sections are those dealing with the pelvis and perineum and the renal part of the abdomen. The chapter on the brain is also as long as that upon the head and neck, approximately three times as long as that upon the thorax. It is really intended to be followed with the present textbook of neurology. Subdivisions of the brain are discussed, as are also ventricles, lobes, meningeal vessels, cranial nerves, tracts, capsules, and nuclei. In many schools this section could be superfluous, since gross neurology is presented as part of a second year course. Neuro-anatomy not a feature of gross anatomical instruction in the dissection laboratory. Yet, where the latter arrangement prevails, the section would prove very serviceable.

BARRY A. SMITH

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Books received here acknowledged in this department, and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

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